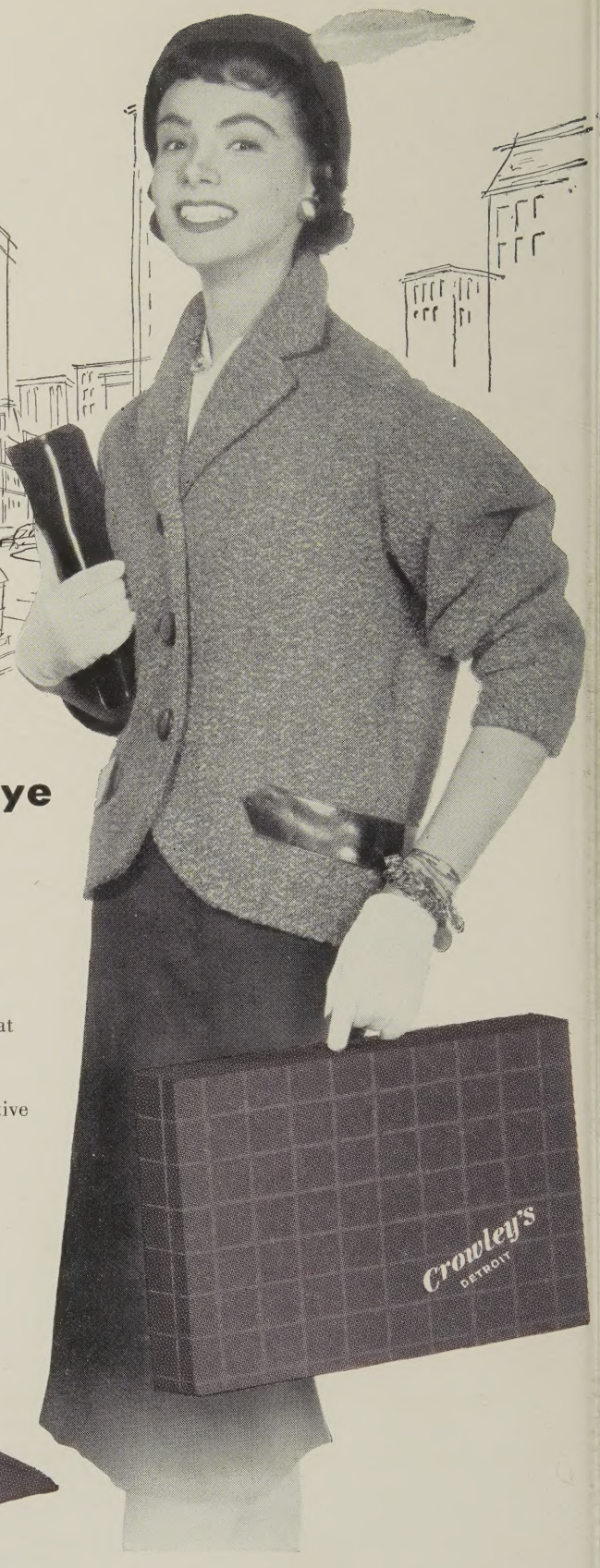
Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

APRIL 1955

VOLUME 38 - NUMBER 4

IN DETROIT . . .



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ad-about-town catches the eye wherever it goes

Shrewd retailers, Crowley's. They've chosen a color uniquely their own, to make every package from Crowley's a "traveling advertisement" that will attract attention all over Detroit.

It'll pay off in orders — and *re*orders — if you help your retailer-customer select a color uniquely *his* own. He'll want that color used on wrapping paper, bags, boxes, gummed tape — every kind of packaging material you sell.

You can offer a wide range of shades, in adapting a distinctive "store-color" for each prospect. For technical assistance in developing a color or selecting the proper dye, simply write to E. I. du Pont de Nemours & Co. (Inc.), Dyes and Chemicals Division, Wilmington 98, Delaware.

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FOR MAXIMUM SOLUBILITY
Du Pont acid dyes

FOR MAXIMUM LIGHT-FASTNESS
Du Pont dispersed organic pigments:

"Monastral"* Fast Blues, "Monastral"* Fast Greens, "Lithosol"* Pigments

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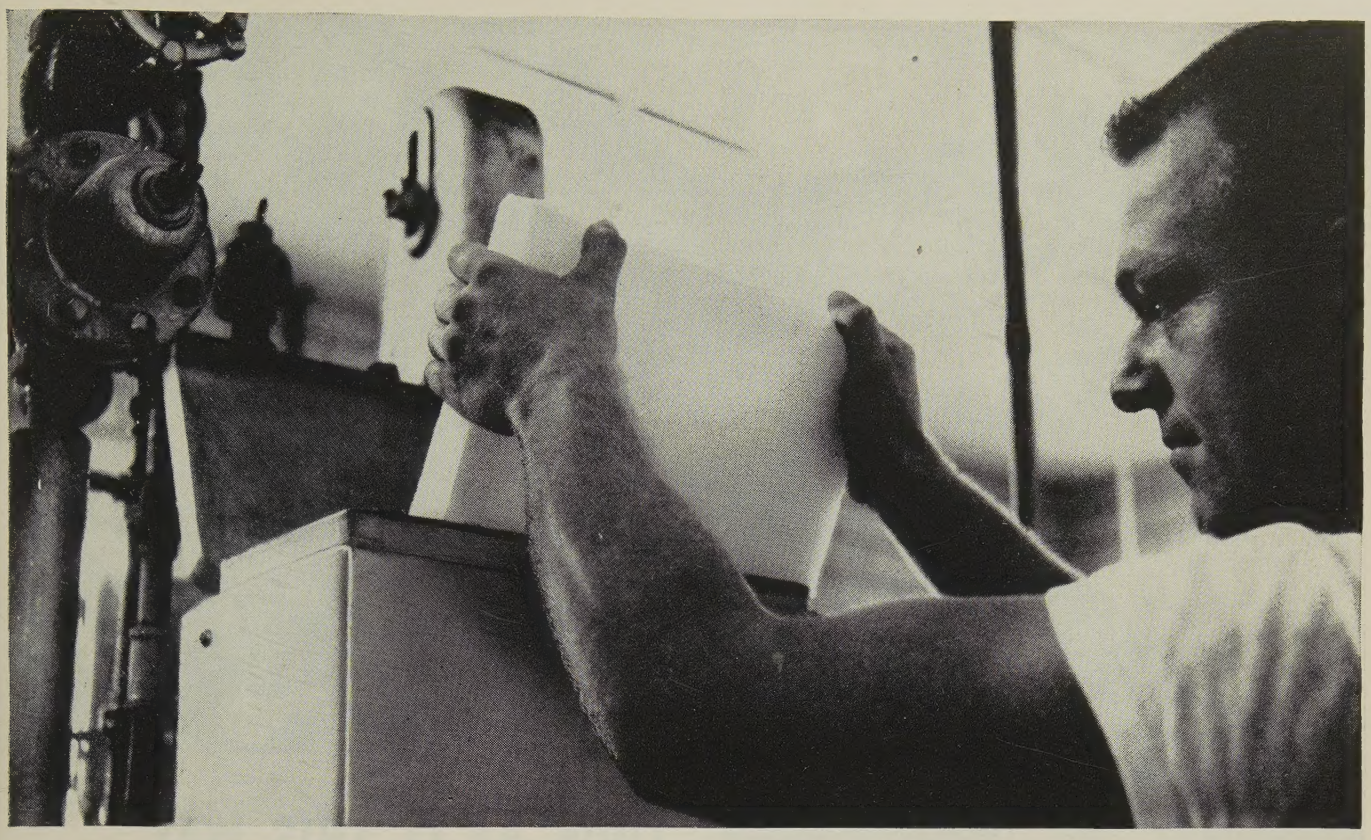


"Fire destroyed wax...normal supplier said 3 weeks... Cities Service delivered truckload same day"

Out of wax at 8. A.M., dairy receives truckload from Cities Service by noon the same day.

Fire had destroyed the entire supply of wax at Country Charm Dairy, Monticello, Illinois—and to replace it through the normal supplier would have taken three to four weeks, meaning an equivalent shut-down.

But President R. C. Miller said he'd have no delay . . . and at 8 A.M. he conceived the idea that saved him from it. He called the Cities Service Representative who'd been supplying his lubricating oils and inquired about wax. By noon that same day, the dairy was back in operation with a truckload of Pacemaker Wax direct from the Cities Service warehouse!

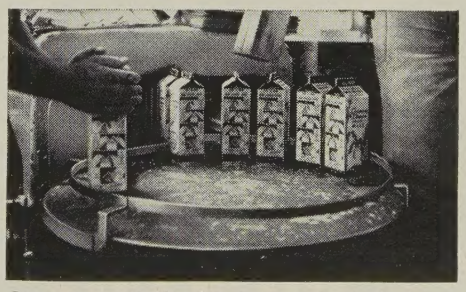
"Ever since, we've been using Pacemaker Wax and the service has kept at a par with our first emergency order," says Mr. Miller. "Cities Service Technical Personnel have helped us every step of the way and thanks to their aid and the excellent sealing and penetrating properties of Pacemaker Wax, our cartons are greatly improved. Needless to say, we're happy to recommend Pacemaker Wax to any wax user."

You'll profit by following Mr. Miller's recommendation. Contact your nearest Cities Service office or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

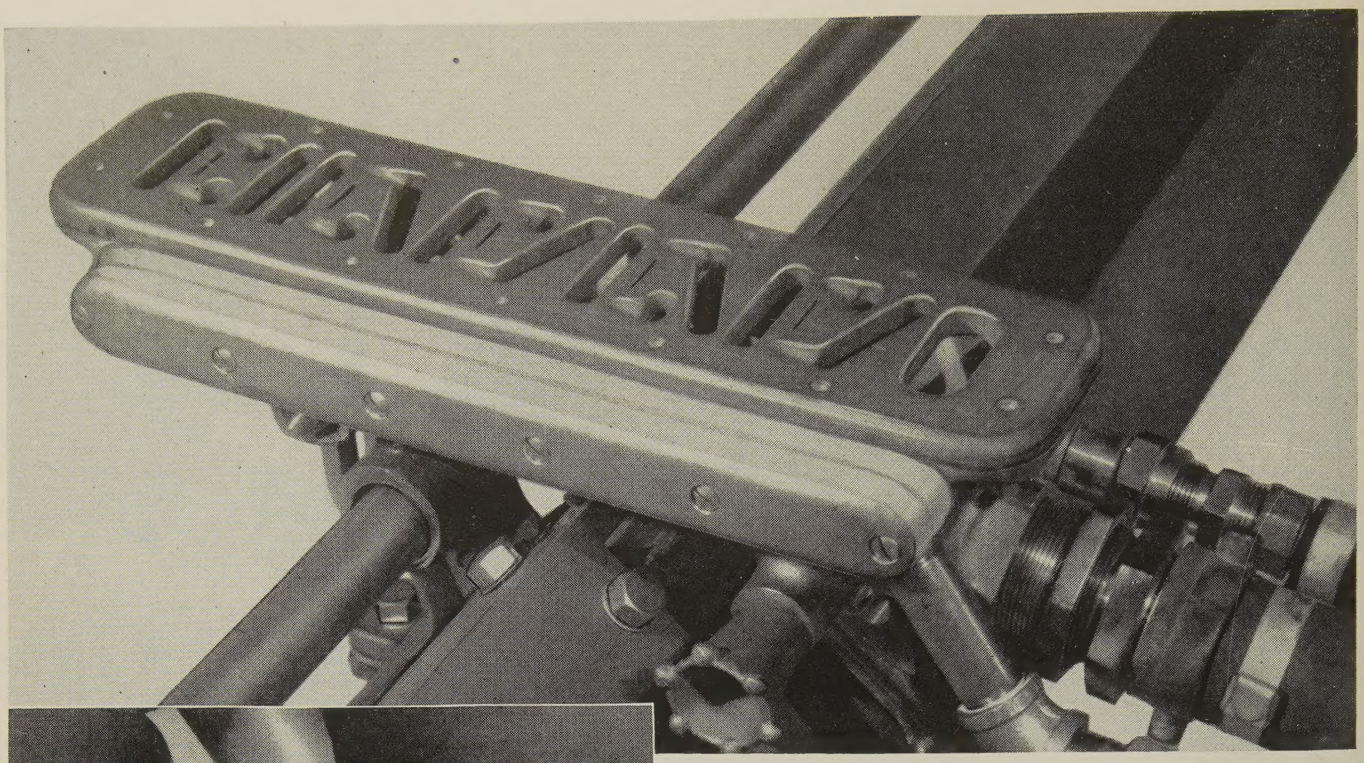
CITIES SERVICE

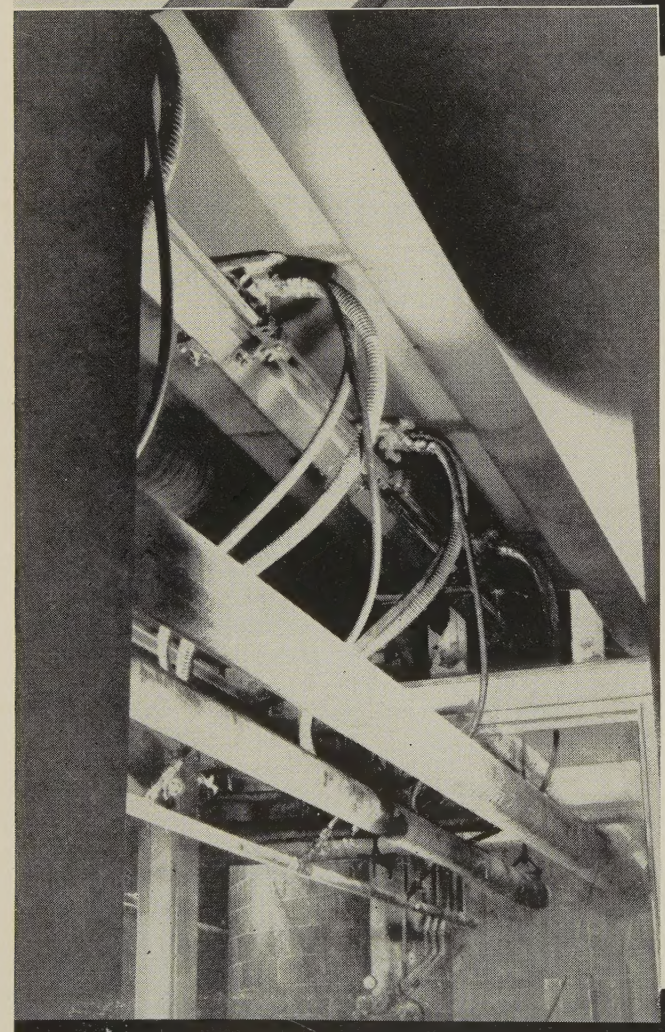
QUALITY PETROLEUM PRODUCTS

Local Warehousing of Cities Service Pacemaker Wax saved the day for Country Charm Dairy. Completely out of wax at 8. A.M. one morning, due to fire, President R. C. Miller called Cities Service and received entire truckload by noon the same day.



Cartons coated with Pacemaker Wax are greatly improved, according to Mr. Miller. He also praises the aid received from Cities Service Technical Personnel. "I'd recommend Cities Service to any wax user," he says.





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VICKERY FELT CONDITIONERS provide low cost protection against expensive, mid-week shutdowns. They help to maintain uniformly good finish. They reduce drying cost. Many users report substantial increases in felt life.

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APRIL 1955

Tappi

VOL. 38 · NO. 4

Published monthly by the Technical Association of the Pulp and Paper Industry

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Published monthly by the Technical Association of the Pulp and Paper Industry at 20th and Northampton Streets, Easton, Pa. Editorial and advertising offices, 155 East 44th Street, New York 17, N. Y. Articles for publication and communications regarding the editorial content of *Tappi* should be addressed to the Editor at the editorial office. Statements and opinions expressed in articles and editorials appearing in *Tappi* are those of the contributors, and the Technical Association of the Pulp and Paper Industry assumes no responsibility for them. Subscription: U. S. and possessions $7.50; Canada $8.25; Pan American Union $9.00; Other Foreign $10.00. Single copies to members of TAPPI $0.75; Nonmembers $1.00. Entered as second class matter January 27, 1949, at the Post Office at Easton, Pa., under the act of August 24, 1912. Copyright, 1955, by the Technical Association of the Pulp and Paper Industry. An index of the technical articles appearing in the magazine appears in the Industrial Arts Index and the Engineering Index.

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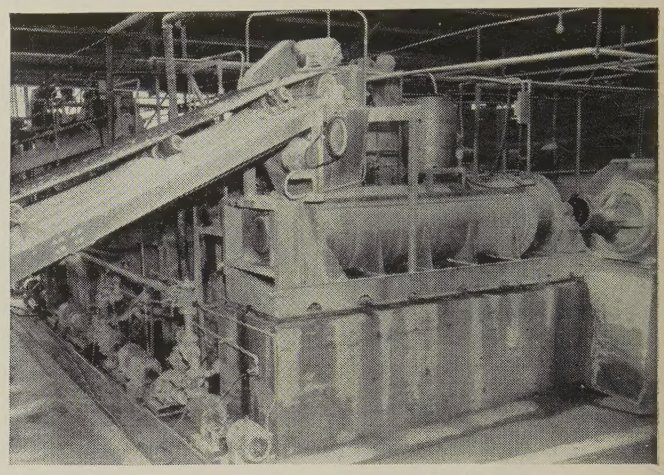
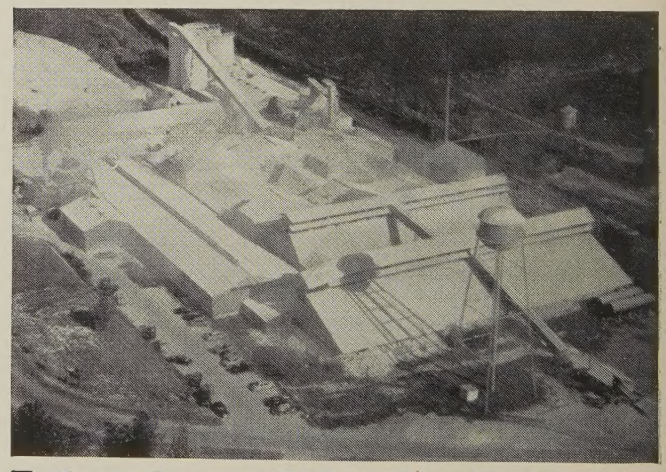
The *total* combined range of Huber products, methods, and services is without duplicate in the industry. Only Huber offers you a total range of production methods: spray, drum, rotary, tunnel dried; *plus* a total range of clays: airfloated, water-washed, filler, coating; *plus* vast storage facilities and selective mining; *plus* unique quality controls such as the patented pugmill process that gives you VISCONTROL —patented viscosity control.

*N. Millman, *Paper Trade Journal,* February 1951.



Viscontrol. Huber's new patented pugmill process for controlling waterwashed clay viscosity, provides you with all the advantages of coating clays with uniform flow characteristics. The process, developed by Huber in 1951*, and proven through actual field performance, significantly reduces the problems associated with modern high-speed coating operations. You are assured faster, more uniform production, with fewer adjustments.



Extensive refining facilities make Huber better able to supply filler and coating clays *exactly* adaptable to your needs. No other clay producer, in fact, utilizes so wide a variety of refining equipment—complete, modern air-flotation plants, hydroseparators for fractionation of crude clay, modern filtering and extrusion equipment and tunnel, rotary, spray, and drum driers.

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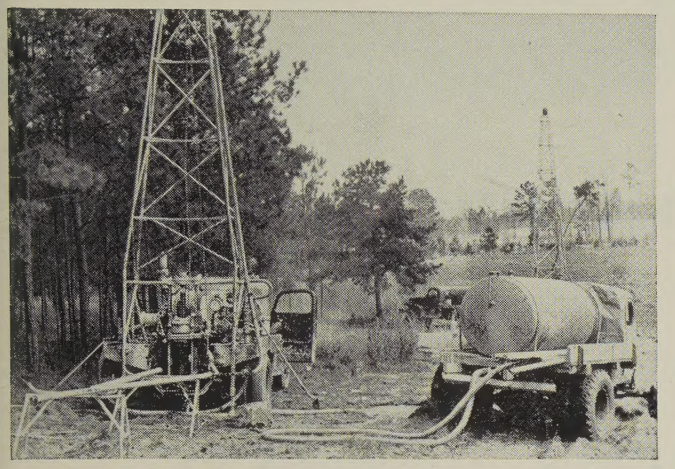
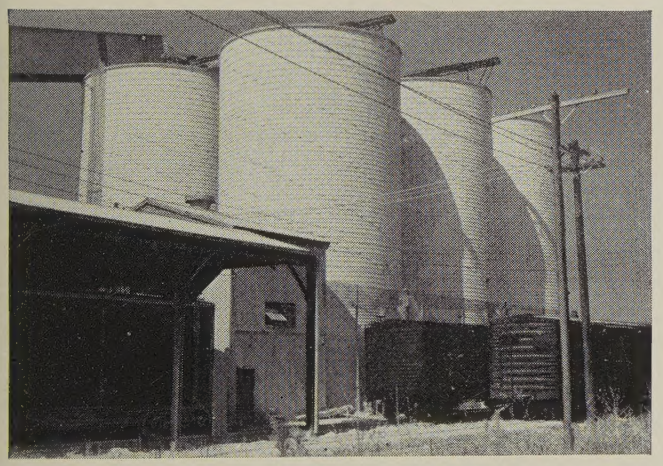
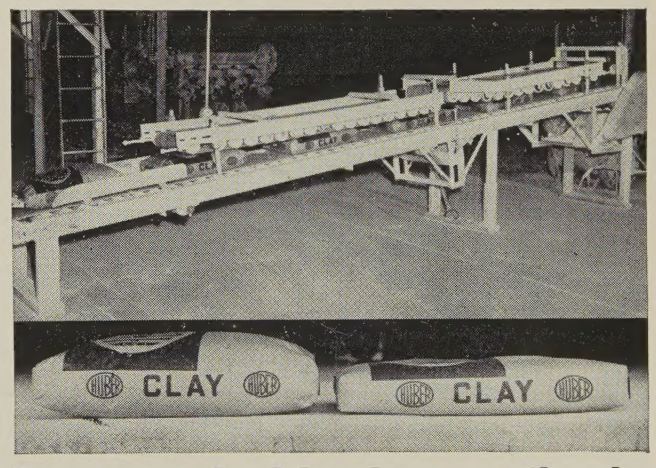


Scientific prospecting is carried on by Huber engineers years ahead of actual clay removal. Long before mining begins, exact properties of the clay in every part of a deposit are established. This prospecting, using every modern technique of sampling and laboratory evaluation, together with VISCONTROL for water-washed grades, guarantees you a plentiful, uninterrupted supply of clay of consistent quality—year after year.

Selective mining from several different deposits is a big factor in Huber's ability to maintain consistency in the quality of its clays. With every necessary facility for carrying on full-scale mining operations in not one, but *several* locations, Huber is *always* able to have in its storage bins abundant clays of precisely the right properties to fill your needs. These facilities assure you of the same quality from day-to-day and year-to-year.



Ample storage capacity is important if sufficient quantities of crude and refined clay are to be kept available above ground as a guard against shortages brought about when bad weather might interrupt mining operations. Huber's vast storage system contains clay sorted and stored according to properties that have been precisely determined in the laboratory.



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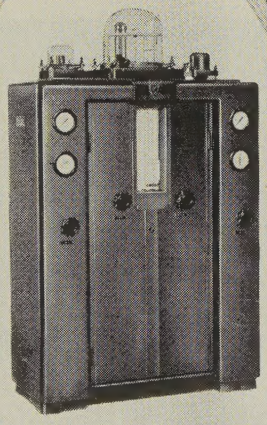

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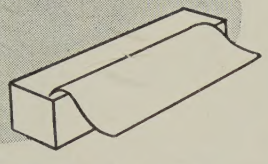

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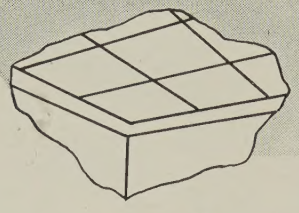

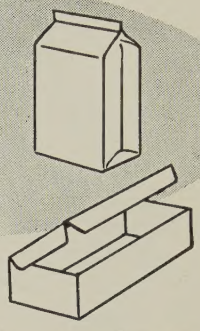

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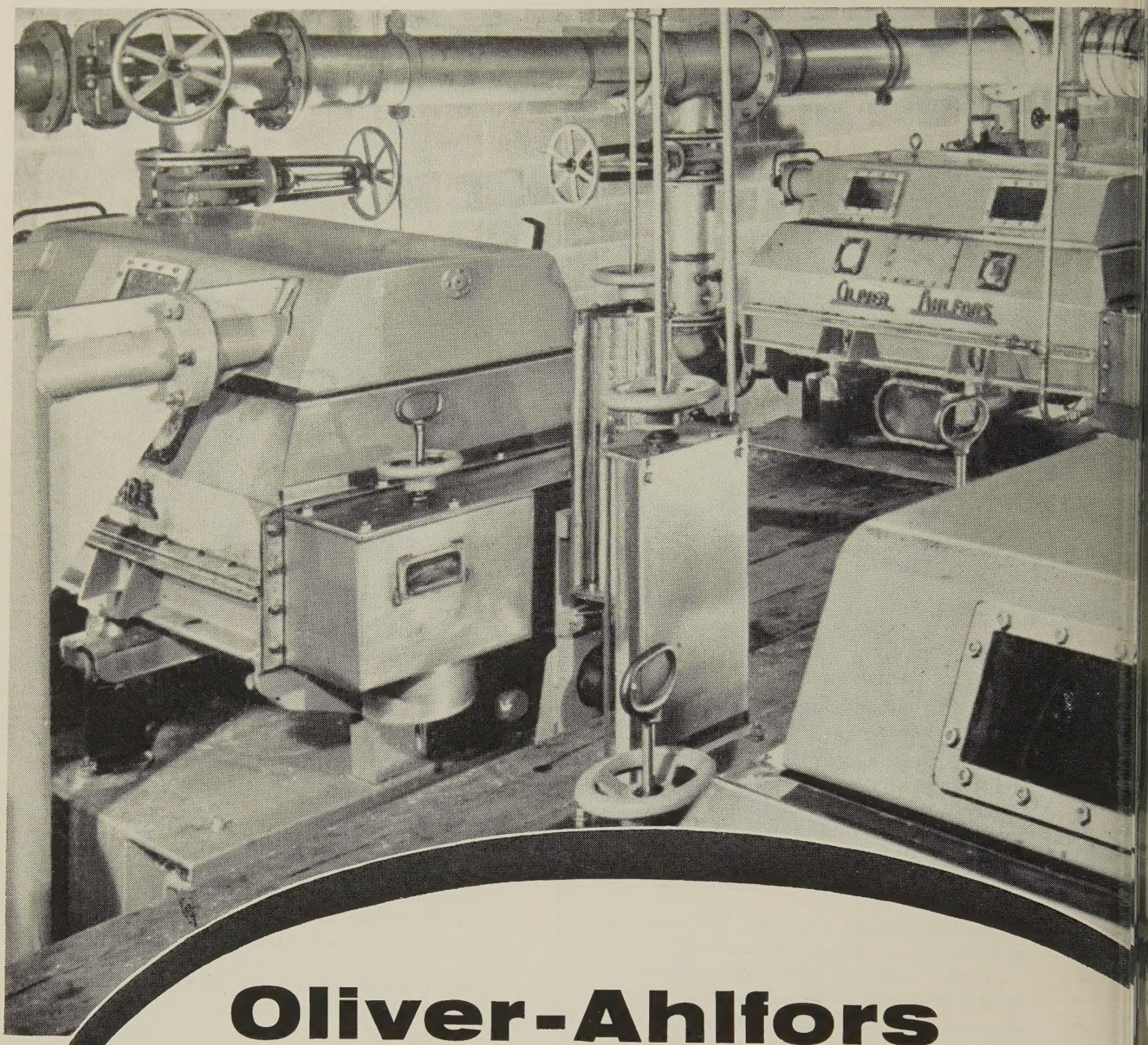
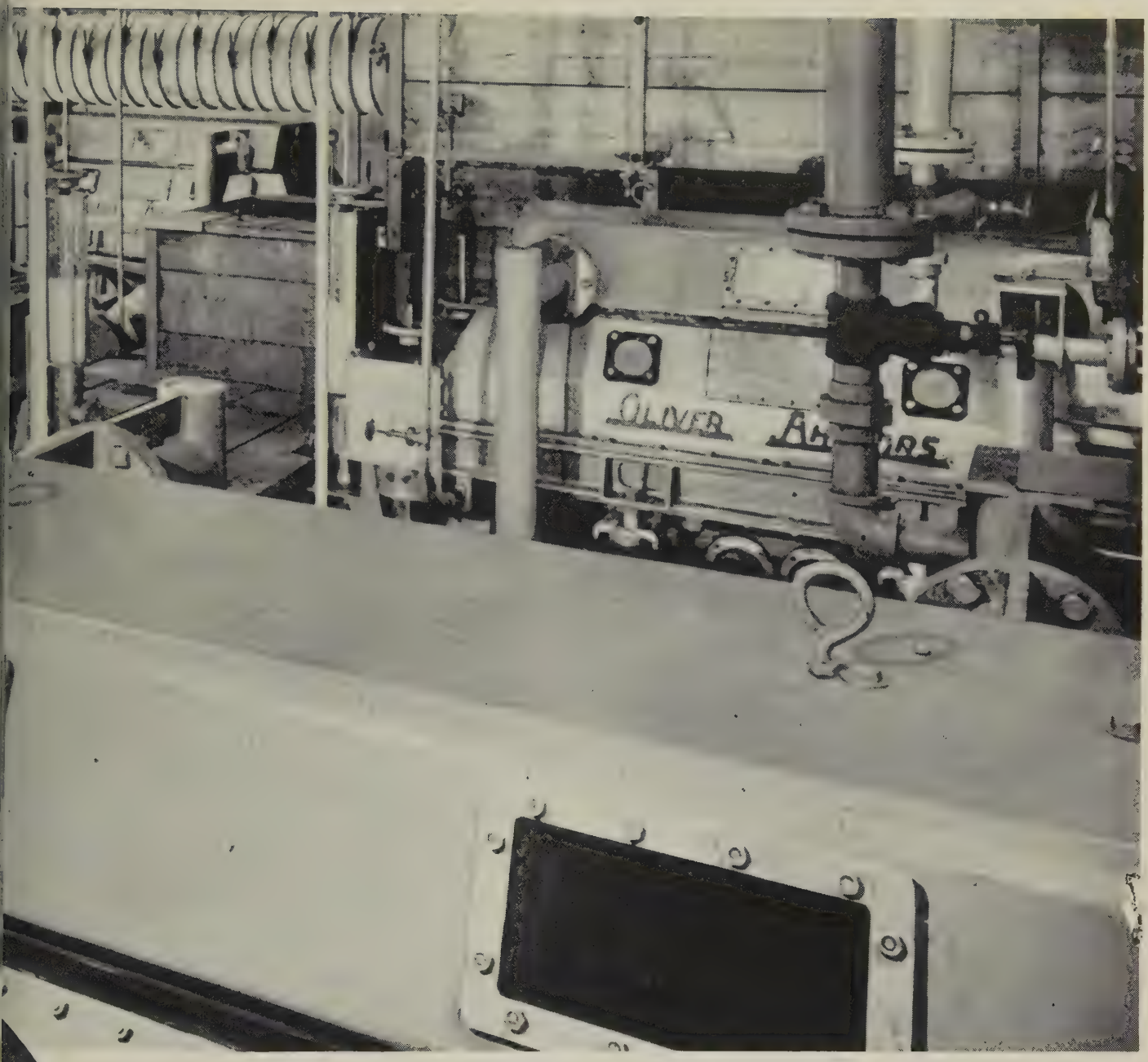


Oliver-Ahlfors Screens Handle 165 Tons of Paper Pulps Daily

in Large Washington Kraft Mill



This compact installation of Oliver-Ahlfors Pulp Screens is located in the St. Regis Paper Company's Tacoma, Washington mill. 165 tons of fully bleached kraft pulp are handled by these screens daily. Of the units shown, five are for primary and one for secondary screening.

The Oliver-Ahlfors Screen differs from conventional flat screens by operating on the "upflow" principle. Accepted fiber is screened upward through submerged screen plates, while the heavier fiber bundles, dirt and scale settle in the screen vat and are withdrawn through adjustable reject outlets. Automatic hydraulic screenplate cleaning showers and screens are totally enclosed to prevent pulp contamination and also contribute to a clean, dry screen room.

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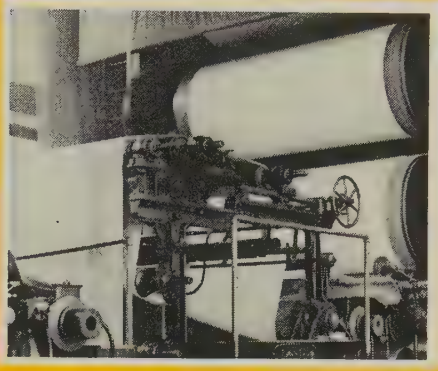

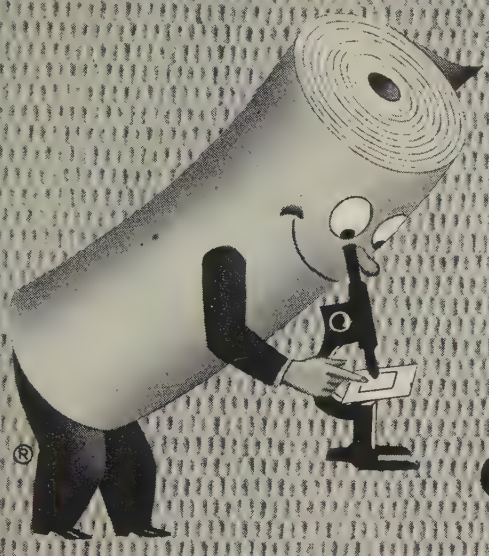

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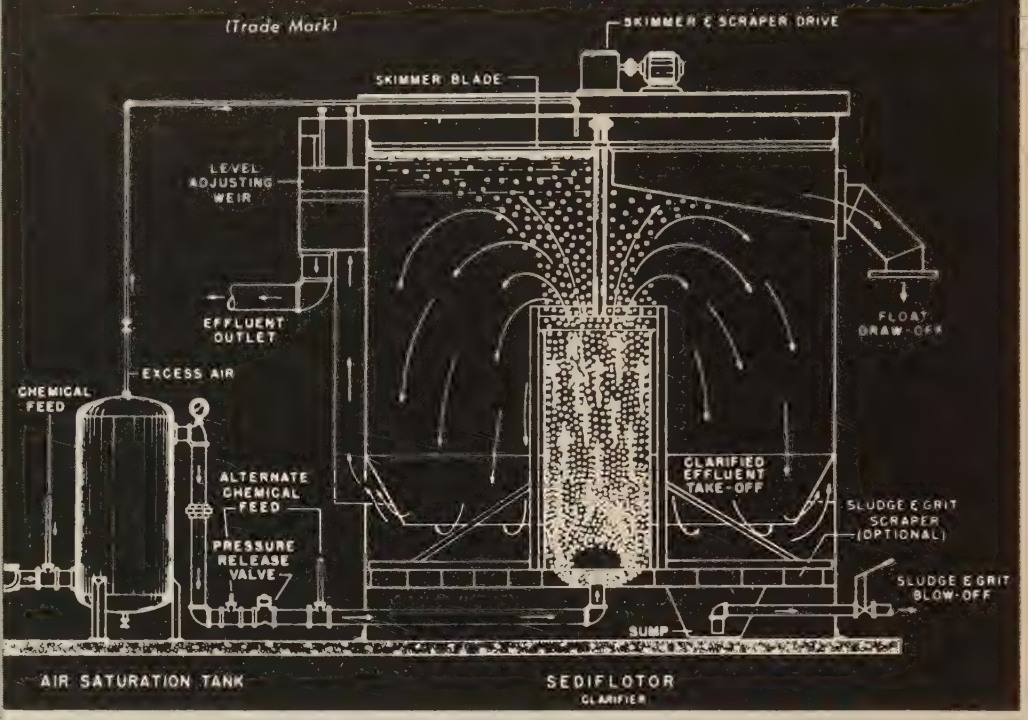

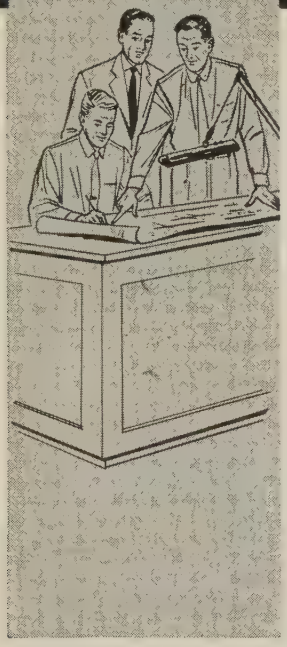

1. "DISSOLVED-AIR FLOTATION" assures rapid removal of suspended fibre material from white water. Based on the principle of "dissolved-air flotation," and incorporating reliable chemical feed and operating control, the "SEDIFLOTOR" clarifier offers substantial savings to paper mill operators. For example, one plant estimates a saving of about $180.00 per day recovering pulp and filler from white water treated at a rate of 300 g.p.m. Whenever flotation is effective, the "SEDIFLOTOR" clarifier produces a float of maximum consistency in a unit occupying a minimum of floor space.

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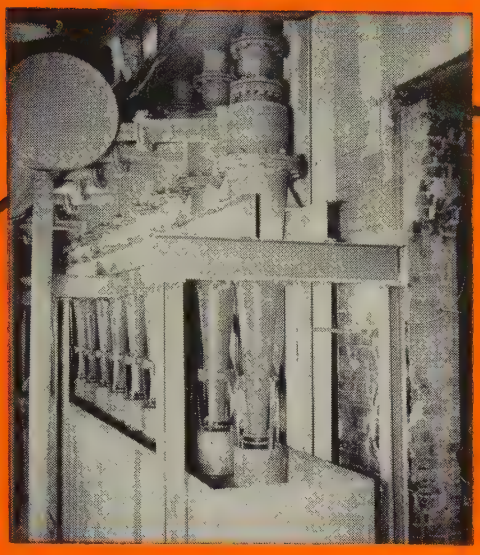

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Agricultural Surpluses—A Challenge to Industry

CLARENCE FRANCIS

THANK you, Mr. President. That was an excellent opportunity to see what my obituary might look like.

You know, however, it was not until that introduction that I really discovered how a prune peddler happened to get into this august body. When you decided to go outside of your industry, you certainly went way outside of it. But why in heaven's name you picked a "retired man," like I'm supposed to be, is a little bit more than I know.

I had just gotten up to the chairmanship of General Foods when I got a letter from one of our salesmen saying: "Congratulations, but I don't envy you. You are now a man without a future."

Sometimes I think he was right. Anyway, here I am, and I'm going to talk to you about something that is pretty remote from your industry, but something that I trust will interest you as citizens.

The time is limited. I will try to pick out the high points that will have some meaning for you.

I'm going to talk with you about surplus agricultural products.

At the present time the Government has $7 billion being used for agricultural surpluses. If you will but consider that the worth of your entire industry is $5 billion, maybe you might get some concept of what $7 billion is—and then try to put yourself in my shoes, with the task of trying to dispose of that, with injury to nobody.

Here is something that I would like you to keep in mind as you think about the surplus. It is costing your Government $700,000 a day for storage purposes alone.

Now, obviously we have that surplus because the domestic consumption and our shipments abroad were insufficient to take care of it. So, a problem arose as to how we were going to increase consumption, and consequently legislation was suggested and passed, known, just to get technical, as Public Law 480. That provided that the CCC, the Commodity Credit Corp.—which holds this $7 billion worth— under Title I, could in 3 years lose $700 million by lower prices; under Title II was authorized to give away $300 million worth in times of floods and other acts of God, and so forth.

You may think that this is relatively easy. But, remember, you have there all kinds and types of interests. You inevitably come into conflict with some departments or other of the Government, which departments have been given their dictates by Congress. The State Department is charged with protecting the foreign operations of our Government . . . the Treasury, with protecting our dollars . . . Commerce, with the protection of our private enterprise . . . Agriculture, to take care of the industry budget (to see that you don't put over anything) . . . while FOA is charged with trying to improve the economies of foreign lands.

However, every one has a different idea. And the task of trying to break those fellows away from their individual concepts into the realization that they have a united job to do for the United States Government has been one of the most interesting personnel jobs it has ever been my lot to have. It's exactly the same thing as if you in your respective companies couldn't get coordinated action in your various departments with regard to the good of the company as a whole.

In our Washington departments we have some of the finest men I have ever met. They are protecting departmental interests as they see them. But to get them to give a little bit in order that we may go ahead is something of a task.

One thing that I think I have learned on the job down there is that the whole world production shows a form of unbalance, if you look at it in narrow sense. So much rice is grown because so much rice is consumed; so much cotton is grown, and so on. The minute you start trying to substitute wheat for rice, you find yourself destroying the economies of the rice-producing nations—and of course you hear about that very quickly from ambassadors and others of those nations' people.

There isn't a single item in surplus that isn't produced to a very great degree by other countries of the world. But as long as we have to get rid of our surpluses, it means that we are interfering with their business. So, between your internal operations and your external operations, it's an interesting experience.

Well, you say, "What are you going to do about it?"

I don't propose to discuss with you the whole, much talked about agricultural program of support prices and parity, and so forth. But one thing to do under the circumstances, of course, would be to reduce the supply.

My training wasn't that way. My training was to build markets, and I would much prefer to get into that particular phase of it. We are trying to devote ourselves to the increasing of the markets in order not to have to decrease production. Because back of ever-increasing production is stability of employment and national well-being.

May I point out one little thing to you, and perhaps do a little bit of selling for a moment? The point is this:

If we could increase the daily consumption of milk in America by one quarter of a glass, per person, we would have no surplus milk, no surplus butter, and no surplus cheese.

Please remember that the next time you order coffee —which happens to be my business, and not milk. But we'll give up a little bit of coffee business for this particular purpose.

Well, let's take a moment for further analysis. I'm going to talk butter first, because that's the surplus you

Presented at the Annual Luncheon of the Technical Association of the Pulp and Paper Industry on Thursday, Feb. 24, 1955, New York, N. Y. Mr. Francis, formerly chairman of the board of General Foods Corp., is special consultant to the President of the United States and chairman of the Intra-Agency Committee on Agricultural Surplus Disposal.

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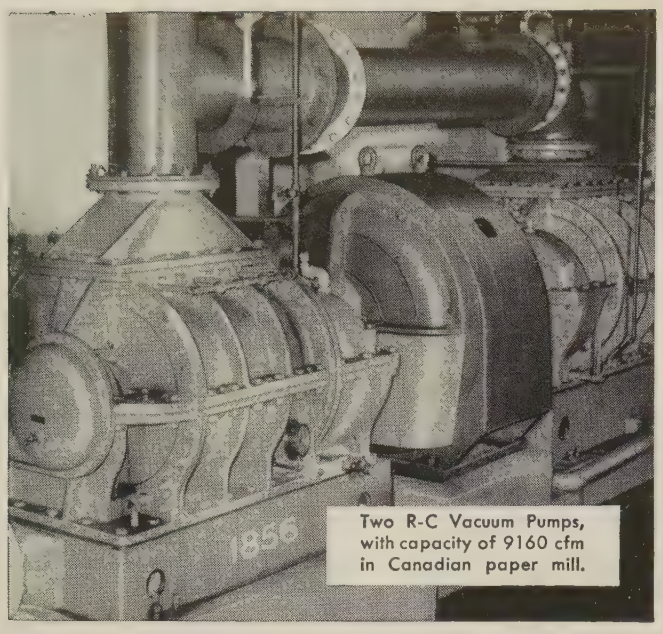

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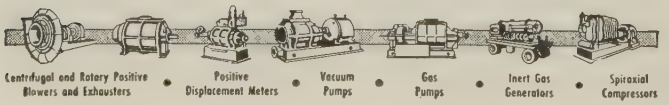

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see in the press. Why, I don't altogether know, because we have quite a problem in other products than butter. But here is the butter story:

We once had close to 500 million lb. of surplus butter. Today that surplus has been reduced to about 250 million lb. That has happened for two reasons.

You may recall that the law did reduce the support price from 90 to 75% of parity. That has had an effect on the production of butter. There hasn't been so much accumulated.

On the other hand, we have found some other ways of selling it. You may have read about ghee. It's a product made from butter that you put in a can and send to the Moslem countries, and the people there like it. You wouldn't like it; but they do. Taste has never been standardized. These sales of ghee are certainly not profitable for us; they went at very low price.

Meanwhile, we have proved an old truth: that when something comes into the market that you can't afford, you do something about it. The chocolate industry has taken to using x per cent of dairy butter in place of high-priced cocoa. So some of the surplus is going in there.

The butter that we are sending to the cocoa people—because here is a new use and we want to get rid of surplus—is sold at about 25 cents a lb. Figure the difference on that. The world price of butter is about 41 cents. Ladies, you know what you're paying for it. Maybe some of the men do, too.

There was a time when we weren't sure what the world price of butter was. Then we tried to get it on a bid basis. And if the ladies weren't present, I'd say all H broke loose all over the world. You see, at that time some people here and abroad had the conviction that if you started on a bid price, you would push the prices all the way down and thus destroy the economies of others.

Some of us didn't think so. And it might interest you to know that we have sold 1 billion lb. of cottonseed oil from surplus on a bid basis. We have sold 500 million lb. of linseed oil on a bid basis. When the excess supply of the oils was taken off the market, the market strengthened, and now everybody is happy. We have an idea that butter might do the same thing.

Then you have heard something about sending butter to Russia. Maybe you read in this morning's paper that the Attorney General said we can't even barter for a strategic raw material, because of a quirk in the law.

There are two schools of thought on that. One is that if you sell butter to Russia for gold or for dollars, if you want to talk about the weakening of it, you have at least weakened them to the degree that what they spend for butter they can't spend for guns. And there may be something in that. At any rate, Russia is one of the biggest consumers of butter.

It might interest you to know, too, that our butter won't go in England and Russia, because of different stipulations. Then maybe you sell your cottonseed oil to people abroad, and they turn it into margarine and perhaps sell their butter to Russia. If that's being done, it's certainly not an intentional operation with us.

The cheese inventory—and it's called good old cheddar cheese, not rat cheese, if you please—that inventory has been reduced by 200 million lb. in such

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This BECKAMINE enables you to *save 50-70% in rosin size.* When you use 0.5% of P-841-30 solids after the refining operation, your rosin size goes further. The strong cationic charge on P-841-30 results in superior distribution and retention of the size.

Last but not least, this versatile RCI resin helps you achieve *better tub and calender sizing* in conjunction with starch. P-841-30 aids in laying fuzz, improves scuff resistance and dimensional stability, waterproofs starch.

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ways as selling it for use by the army, selling it abroad, and seeing that it's available for school lunches, meaning that we are trying to get it off the market on the best possible terms.

Now let's get on to powdered milk. We were facing a surplus of a billion (mind you, a billion) pounds of powdered milk, and people said: "Sell it throughout the world. People need milk. Give them something to drink."

Well, there are many places that know the taste of goat's milk, and mother's milk, but they don't know anything about cow's milk. Furthermore, if you send powdered milk they haven't the equipment in which to convert it, or the bottles in which to ship it. They have no sanitation, no refrigeration, no means of distribution—as well as no taste.

Now, believe me, we tried very hard to get somebody to drink milk. And what do you think we did when we found ourselves in an impasse?

Powdered milk is very high in protein. So we sold it back to the farmers to feed the cows to make more milk.

Well, we know what to do with powdered milk, if it accumulates again.

Now we come to wheat. And I realize that we have some of our Canadian friends here today, and they could testify better than we as to what their situation is on wheat.

It might interest you to know that this side of the border we have $2^1/_2$ billion tied up in wheat. We have virtually enough wheat in surplus today to supply the American public for 2 solid years.

We have Australia with more wheat, and Canada with more wheat, and Argentina with more wheat, and the world with more wheat, and we have got to get rid of that wheat.

Well, if anybody in here with a research mind gets some good ideas on that subject, I'll stay here and listen to him, or them, all night. Wheat is about the toughest problem we have. I'm not so sure that the outcome of that might not be to put it back to feed, from whence it came, at a reduced price at your expense.

Well, we come to another one: cotton.

We have $1^1/_2$ billion tied up in cotton. We are the residual suppliers of cotton, so to speak. And we are instrumental in setting the world price of cotton. Too low a price would not aid our economy, and could be very destructive to the economies of friendly countries. Regardless of our price, these countries must sell their supplies because of the importance of cotton to their economies. You can see that when their cotton is all gone, we get whatever business is left.

At the moment cotton surplus disposal does not seem to be impossible. If things don't go too badly for the next 2 or 3 years, we may be out from under.

But I'd like to take one second to tell you gentlemen in the paper industry that we have in surplus 1 million bales of cotton linters. Somebody told me that you might be able to use that in paper—at a price.

At least you might if you were assured of a supply for a few years.

Now I can make no promises, gentlemen, but if anybody has a good idea on that subject—which would seem to point to a brand new use for linters—then I'm waiting to see him. If you have someone here who will go to bat for an idea like that, you will in my book be rendering a great service.

I am about through; but I do want to add that after being down in Washington virtually a year now, and seeing what lack of food means to other countries, I thank God I'm in a country of surpluses.

I'm really very thankful that we have surplus food, from which to make some contributions to the world. I'm not condoning the way it happened and why.

The bother is the excess surpluses. I hope we will always have some surplus, as insurance.

Right now we have a bad problem, and it is calling forth all kinds of ways and means that no businessman likes to have to follow. Call surplus an evil, if you will—and say it is taking evil ways to get rid of it—but we are doing our best. If there is a justification for talking to you as citizens, it is that my committee would like ideas.

At times we would like to have your sympathy; we actually need your ideas.

Well, before coming to your meeting I jotted down a few notes from a study of your industry. Let me give you those notes, since they show I think you must hold your heads up in pride for the accomplishments that you have made.

Sometimes history is important; it does something inside of you and makes you want to continue.

I mentioned the worth of your industry, a moment ago, at about $5 billion. That's a lot of money. But over the time you have been coming up to that figure, can there be any question about how you have increased the number of jobs, increased employment in these United States? About how you have increased real wages. Or that you have gone a long way toward stabilizing employment?

And then, as your president reminded us a moment ago, see what you have done with your forests, the development of them, and the protection of them for the present and the future.

You certainly are research-minded, and you are continuing with research on all fronts. You have produced and will continue to produce new methods, new uses, and new products.

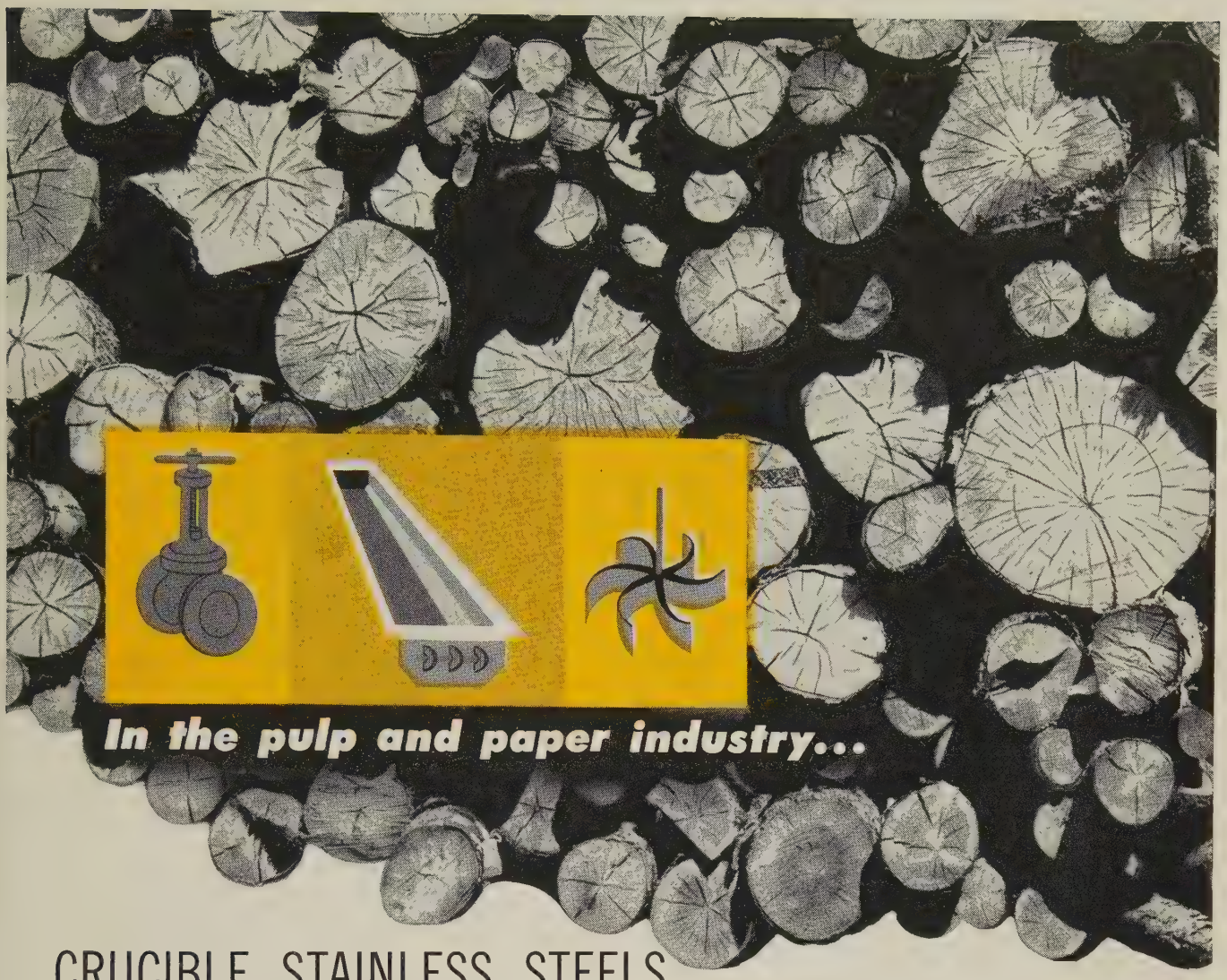
There isn't any doubt but that you are training personnel for the future. However, I challenge you and ask you whether or not you are doing it adequately. The matter of personnel ready and able to meet the management problems of the future is something that each industry has to take home to itself; and perhaps each industry, in associations, should give attention to it.

You certainly are dissatisfied with the present and are demanding of the future. Now, if that's not the American way, I don't know what is.

There isn't any doubt that you have contributed greatly to our economic development and to our improved standard of living. And that's the true gage of progress in any country.

The records are clear that you are forging ahead very, very rapidly. I can't do anything else but salute you for a perfectly marvelous record.

I wonder if you realize this: that since 1879 the United States population has grown $3^1/_3$ times greater, but your output is 60 times greater. Do you realize that the use of paper in the free world is 10 times that



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of the communist world, and that in the United States it is 50 times greater? Now just think of that for a moment!

If paper is a means of communication, of spreading information, the building of education, there may be some definite relationship between paper and the standard of living. We might also conclude that as paper goes, so goes civilization.

Here let's take one little look ahead with today's civic-minded industrial leaders. At present, with 164 million people, we have 61 million jobs. Births are at 4 million a year; and we have a net population increase of $2^1/_2$ million. Sixteen million jobs have been created in the last 15 years. There is every indication that we will need to increase them more than that in the next 15.

Is there any doubt that we must have a dynamic economy, not unduly controlled?

The fewer the controls, the better for our own decency of action. But give us a highly competitive economy and one operating in the interests of all segments of our society. I don't know where else you are going to get those jobs I mentioned but in industry. That brings us right plunk down again to the task of better values, better processing, new products, and new processes.

In this connection, the responsibility of the men of TAPPI is very, very great.

I wonder if you realize that as you do your part to increase industrial efficiency, you increase another surplus: the surplus of time. Since it is industry that creates this surplus, it is industry that must assume a large share of the responsibility for seeing that such time is properly used. Surplus time, spent in a proper fashion, can be constructive; surplus time, improperly used, can be a tool of destruction.

It is hardly necessary for me to bid this group to keep the faith. But I think we might together pledge our faith. If we ever had occasion to have trust in each other, trust in the Government, trust in the American way, I think we have seen it during this transitional period. Let's not rest on that.

Your record indicates that you can be relied upon. I am sure of it.

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The TAPPI Statistics Committee announces the 4th Annual Conference on Statistics in the Paper Industry, at the Forest Products Laboratory, Madison, Wis., July 10 to 23, 1955.

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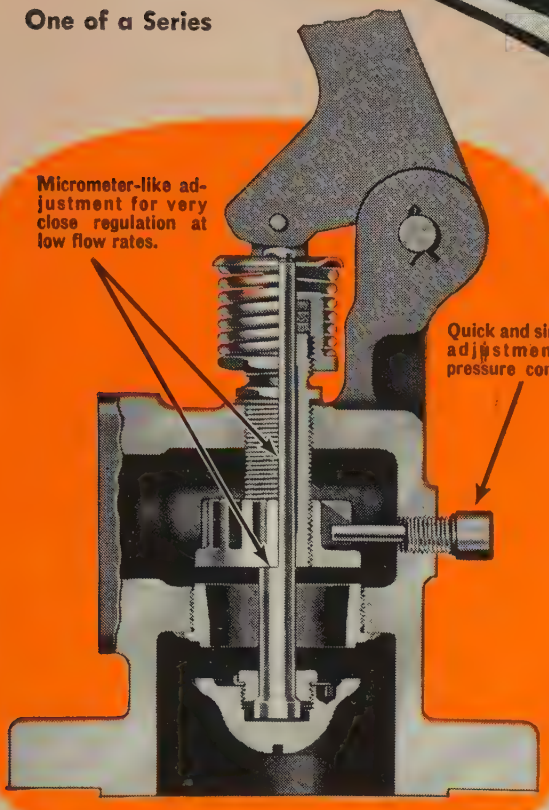
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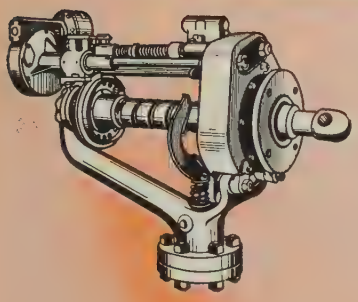

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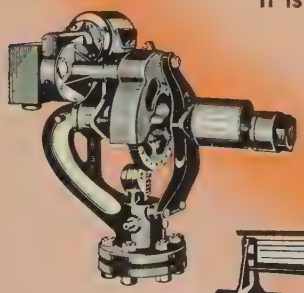

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DIAMOND POWER SPECIALTY CORP.

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Diamond Model IK
Long Retracting Blower

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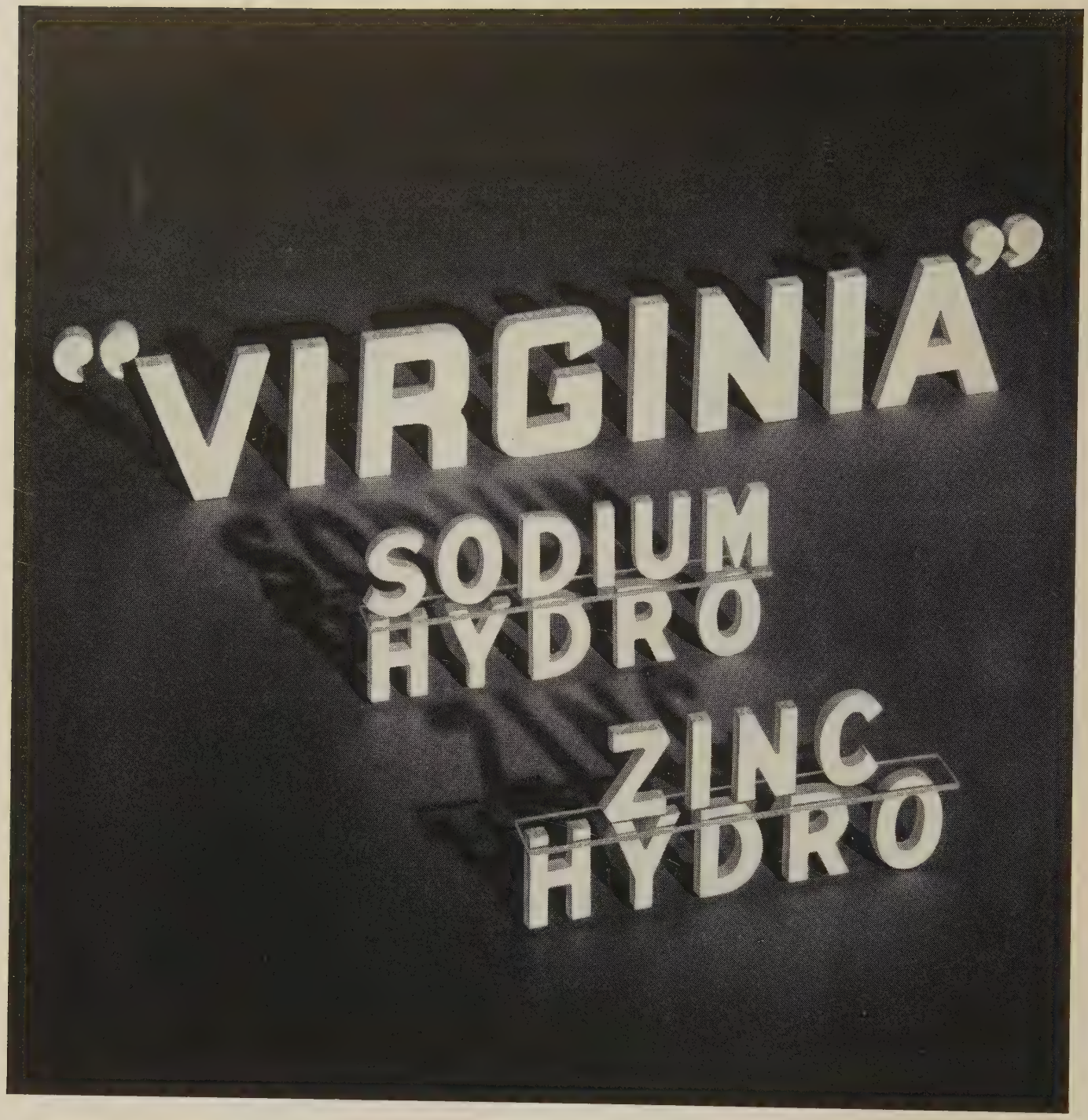

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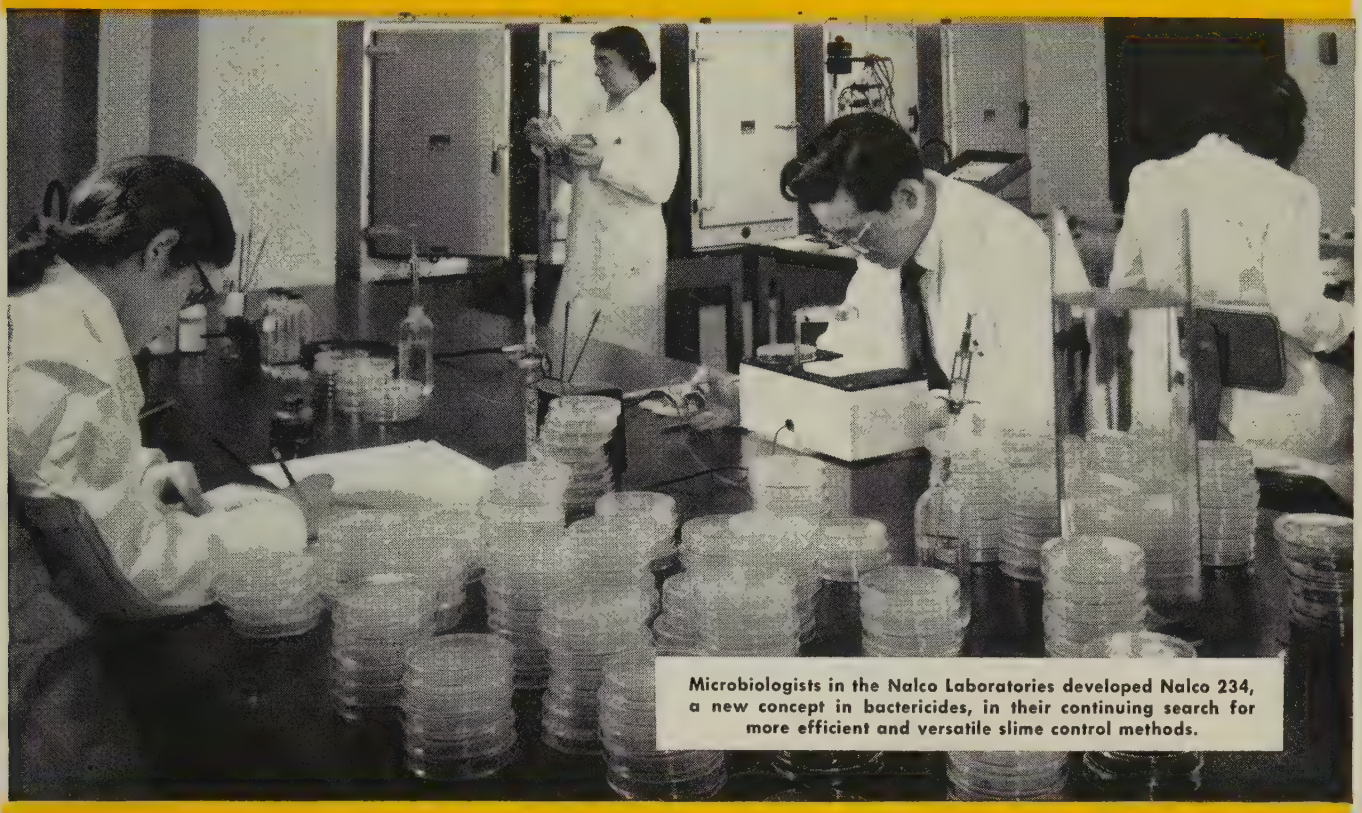

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Relative Toxicity of Disinfectants Available for Use in the Pulp and Paper Industry

1954 Supplement

B. F. SHEMA and J. H. CONKEY

A PREVIOUS report (*1*) contains the relative toxicity for 93 materials to the four test organisms: *Aerobacter aerogenes*, *Bacillus mycoides*, *Aspergillus niger*, and *Penicillium expansum*. All of the materials included in that report are not commercially available nor are they all used extensively in the pulp and paper industry for microorganism control. These materials were included in the study because: (1) the materials have a potential value, and (2) their chemistry may prove to be helpful in formulating and in developing more effective and versatile materials for the pulp and paper industry.

This study, as well as the previous study, is a part of a general program of biological research carried out at The Institute of Paper Chemistry for the Biological Control Committee of the American Paper and Pulp Association. The committee will include in this phase of their program those materials which are of interest to the industry or those which may prove to be effective in the control of objectionable forms of microorganisms in pulp and paper mill systems, on papermaker's woolen felts, and on the finished product. However, the nature of the active ingredient must be disclosed before the committee will accept and/or evaluate the material under their program.

This first supplement to the report published in 1953 contains the relative toxicity for 16 additional materials.

B. F. SHEMA and J. H. CONKEY, Institute of Paper Chemistry, Appleton, Wis.

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The Biological Control Committee of the American Paper and Pulp Association has adopted the policy of publishing a supplement each year. At the end of each fifth year the relative toxicity data will be summarized into a complete report.

The method of determining the relative toxicity of the materials included in this report is the same as that used in the previous study.

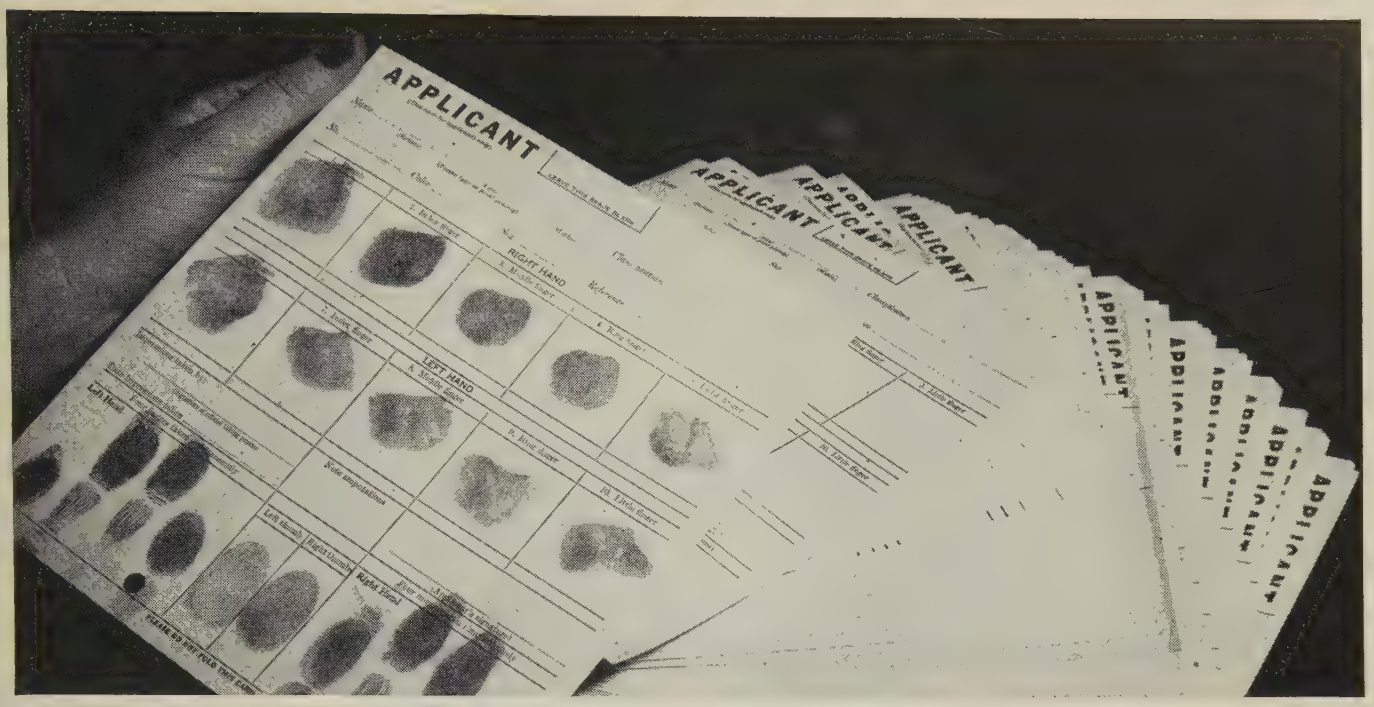
The relative toxicity data for the 16 materials studied is presented in Table I. The active ingredient(s) and the suppliers of the materials included in this report are given in Table II.

The relative toxicity of the Cunilate and the Cunimenes was determined only for two species of fungi because these materials are intended to be used primarily as fungicides for the preservation of paper products rather than for microorganism control in pulp and paper mill systems. A portion of one of the samples of Cunimene (D 2536) was heated at 350°F. for 7 days to determine whether heating has an adverse effect on the biological activity of this formulation. This particular formulation is compatible with hot asphalt. The results indicate that the active ingredient in the formulation is not lost during the heating period. Although there is a significant increase in the toxicity of the heated product, it is not likely that heating the sample actually increases the toxicity of the active ingredient on a weight basis. It is believed that heating the sample results in the loss of volatiles other than the toxic agent. This loss, therefore, increases the actual concentration

Table I. The Relative Toxicity of Various Materials to *Aerobacter aerogenes*, *Bacillus mycoides*, *Aspergillus niger*, and *Penicillium expansum*

Trade name of disinfectant	*Inhibiting Concentrations* — Aerobacter aerogenes		Bacillus mycoides		Aspergillus niger		Penicillium expansum	
	Per cent by weight	*P.p.m.*	*Per cent by weight*	*P.p.m.*	*Per cent by weight*	*P.p.m.*	*Per cent by weight*	*P.p.m.*
5-Acetoxymercurivanillin	0.0005	5	0.00007	0.7	0.2	2000	0.004	40.0
Actamer	0.003	30	0.00002	0.2	>0.3	>3000	>0.3	>3000
A-36	0.002	20	0.0004	4	0.0045	45	0.0035	35
BCD 955	0.085	850	0.004	40	0.2	2000	0.1	1000
Busan	0.04	400	0.0004	4	0.075	750	0.04	400
Butrol-8	0.0004	4	0.00004	0.4	0.002	20	0.002	20
Calcium formate	>0.3	>3000	>0.3	>3000	>0.3	>3000	>0.3	>3000
Cunilate 2493	...	...	...	...	0.045	450	0.2	2000
Cunimene D 2601	...	...	...	...	0.015	150	0.015	150
Cunimene D 2607	...	...	...	...	0.015	150	0.015	150
Cunimene D 2536	...	...	...	...	0.055	550	0.07	700
Cunimene D 2536[a]	...	...	...	...	0.025	250	0.035	350
5-Hydroxymercurivanillin	0.0007	7	0.00006	0.6	>0.05	>500	0.0045	45
8-Hydroxyquinoline	0.007	70	0.0003	3	0.1	100	0.0045	45
Movidyne	0.03	300	0.0002	2	>0.3	>3000	>0.3	>3000
Slime-trol RX3	0.06	600	0.0009	9	0.009	90	0.0095	95
Vancide F-999	0.04	400	0.0004	4	0.003	30	0.0025	25

[a] Heated at 350°F. for 7 days.



FINGERPRINT RECORDS are well preserved on Pexol-sized cards. The excellent and uniform sizing protects the cards from damage due to handling and accidental wetting.

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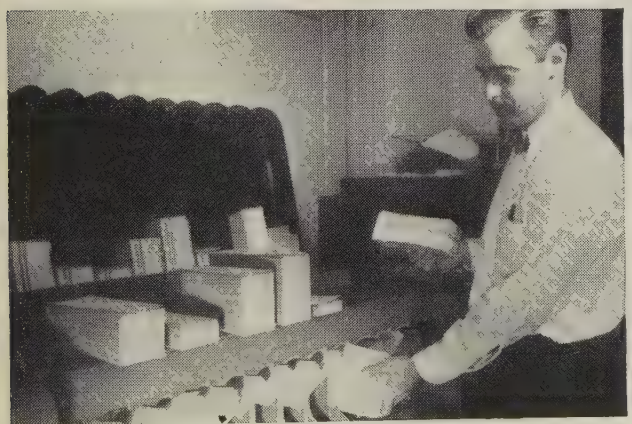
Paper and board destined for a multitude of end uses do the job better when they have been properly sized. That's why mills rely on Pexol for optimum sizing efficiency.

Like all Hercules papermaking chemicals, Pexol fortified size is available in numerous types to insure that there is one best suited for your own manufacturing requirements. Hercules' extensive research and service facilities put more than forty years of experience in the papermaking industry at your disposal.



FINGERTIP CONTROL of complicated files is practiced with modern automatic machinery. File cards inadequately sized are subject to serious damage or may be useless on becoming wet. Pexol, Hercules fortified size, provides the required protection.

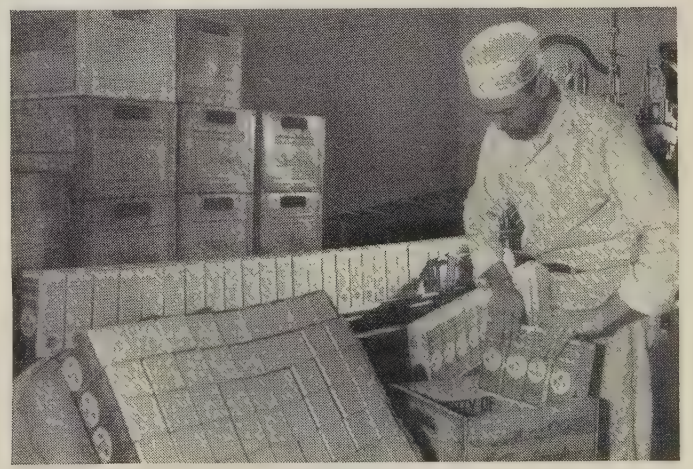


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Table II. The Active Ingredients and the Supplier of the Various Materials Evaluated for Their Relative Toxicity of Two Species of Bacteria and Two Species of Fungi

Trade name of disinfectant	*Active ingredient*	*Supplier*
5-Acetoxymercurivanillin		The Institute of Paper Chemistry
Actamer	4,6-Dichlorophenol	Monsanto Chemical Co.
A-36	Phenylmercuric acetate and colloidal silver	United States Movidyn Corp.
BCD 955	Mixture of sodium salt of 3(1-hydroxyethylidene) 6-methyl 2-H pyran 2,4 (3H) dione, sodium borate, and copper-8-benzazine	Milport Chemical Co.
Busan	Mixture of phenylmercuric acetate and a quaternary ammonium compound	Buckman Laboratories, Inc.
Butrol-8	Mixture of phenylmercuric acetate and 8-hydroxyquinoline	Buckman Laboratories, Inc.
Calcium formate		Trojan Powder Co.
Cunilate 2493	Solubilized copper 8-quinolinolate	Scientific Oil Compounding Co., Inc.
Cunimene D 2601	Rosin amine pentachlorophenate	Scientific Oil Compounding Co., Inc.
Cunimene D 2607	Dehydroabietyl ammonium phenoxide	Scientific Oil Compounding Co., Inc.
Cunimene D 2536	Dehydroabietyl ammonium phenoxide (asphalt base)	Scientific Oil Compounding Co., Inc.
5-Hydroxymercurivanillin		The Institute of Paper Chemistry
8-Hydroxyquinoline		Buckman Laboratories, Inc.
Movidyne	Colloidal silver	United States Movidyn Corp.
Slime-trol RX3	Copper sulphate plus sodium pentachlorophenate	W. H. and L. D. Betz Co.
Vancide F-999	Octachlorocyclohexane	R. T. Vanderbilt Co.

of the active ingredient in any given weight of the heated material.

It must be remembered that these data indicate the relative effectiveness of these materials under a given set of conditions in the laboratory. However, the data are important to the mill operator because they are an index of the biological activity of the materials. However, for a more critical evaluation of the materials the agents should be evaluated under the range of conditions which exist in a given mill system over a period of time which should include the range of operating conditions. Because of variations in price structure of these materials and the effect of different operating variables on the biological activity of the material, no attempt has been made to evaluate these materials on a cost basis. The economics of a given material can be determined best under actual use conditions in a given mill system.

LITERATURE CITED

1. Shema, B. F., and Conkey, J. H., "Relative Toxicity of Disinfectants Available for Use in the Pulp and Paper Industry," American Paper and Pulp Association, 18 pp. (1953); *Tappi* 36, No. 11: 20A, 22A, 24A, 26A, 28A, 30A (1953).

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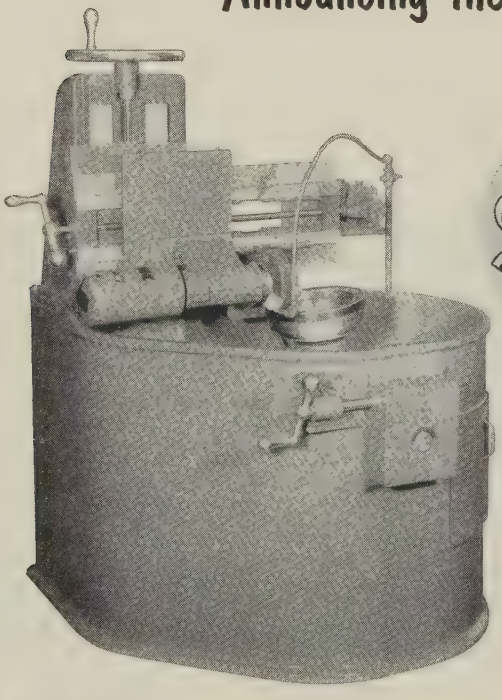

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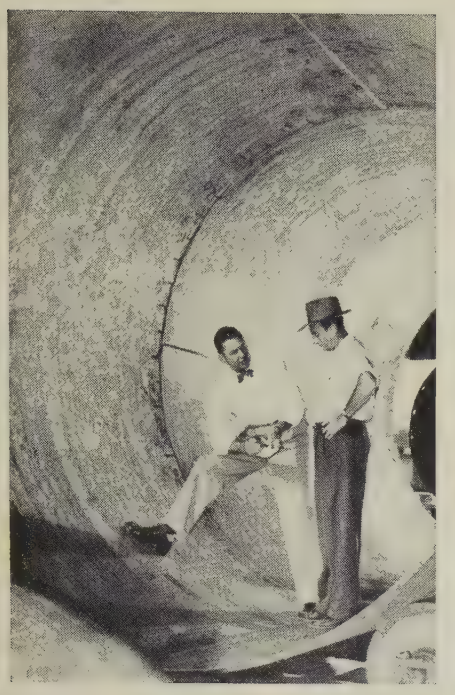
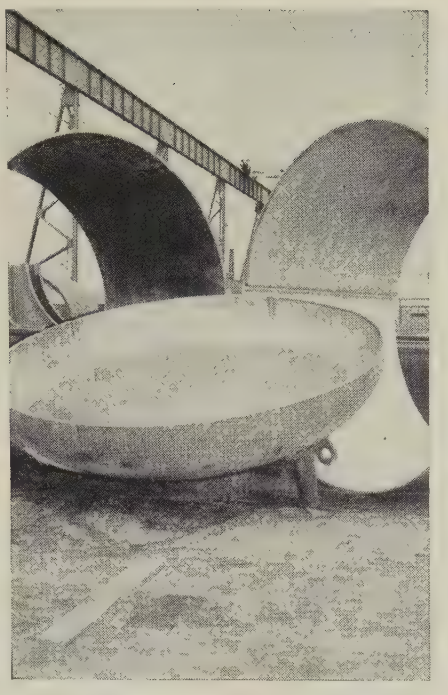
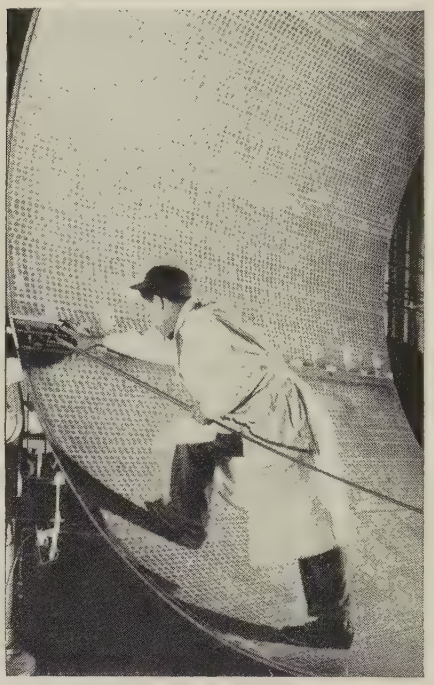


Lukens Steel Corp., Coatsville, Pa., makes Lukens Inconel-Clad Steel to combat digester corrosion. Inconel is clad to a steel backing by rolling under great pressure and at high heat.



Chicago Bridge & Iron Co., Chicago 4, fuses corrosion-resisting Inconel to a steel backing to make HORTONCLAD steel. The bi-metallic plate thus formed is integrally and continuously bonded by a special high vacuum process.



A. O. Smith Corp., Milwaukee 1, Wisc., uses its exclusive SMITHLINING, a closely controlled resistance welding process, to inseparably bond the Inconel lining to a carbon steel backing to provide corrosion resistance and strength.

All 3 Methods offer economical ways to get Inconel Protection for sulfate digesters

Sulfate pulping liquors in the modern mill often show little respect for mild steel digesters.

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That was much too high. So they started looking for a more satisfactory material. Their final selection? Inconel® — because of its resistance to both corrosion and stress corrosion cracking.

To save unnecessary expense, the new digester was made of Lukens Inconel-Clad Steel. (Inconel cladding is 10 to 20% the thickness of the steel plate to which it is bonded. There is a worthwhile saving in cost, yet no sacrifice in strength or corrosion resistance.)

After 4 years of use, this Inconel-Clad digester shows no measurable corrosion. It's still too early, of course, to hazard a guess on how long the digester will eventually last. But so far everyone is well satisfied with its performance.

This is not an isolated case. A recent study by the Tappi Digester Corrosion Subcommittee in 12 mills substantiates the findings of the continuing corrosion tests made by several mills in cooperation with our Corrosion Engineering Section for over 10 years.

Shown here are three methods of securing Inconel protection against alkaline pulping liquors—SMITHLINING, HORTONCLADDING, and LUKENS-CLAD. Although they are fabricated by different techniques, they offer the same long-lasting protection of Inconel. All three have been tried and proven in use. If you are troubled by accelerated digester corrosion, at least *one* of these methods of getting "Inconel protection" will be an answer.

Expert help with the planning of a new alkaline digester is available. Write to the companies mentioned in this advertisement, or to Inco's Corrosion Engineering Section. We'll be glad to give you all the help we can.

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Far Infrared Heating in the Paper Industry

W. L. THOMSON, S. DALHEIM, and V. T. STANNETT

DURING the past 20 years, electricity has become a widely accepted means of applying heat industrially by conduction, convection, and radiation. Of these three mechanisms by which heat may be transferred, radiation provides some unusual values, which were first demonstrated by the use of infrared lamps at Ford Motor Co. in 1935. Here, radiation was used to accelerate the drying of automobile finishes. As the number of lamp infrared installations increased and the industry was again and again able to reappraise infrared as a production tool, there arose a demand for a better source of radiant energy which would be shockproof, splashproof, uniform, more mechanically durable, controllable, and most of all, capable of delivering radiation at higher intensity.

RADIATION VERSUS CONVECTION

Because both convection and radiation are capable of transferring heat from a source to the work material without contact, they are naturally considered together when contact-free heating must be performed. Due to the insulating effect of the boundary film of air which adheres tightly to all surfaces, gravity convection becomes exceedingly slow (see Fig. 1), and the method, therefore, becomes more and more inconsistent with economy and ineffective as operating speeds increase.

Forced convection of heated air directed at the work assists in breaking up the boundary film, but has the disadvantage of requiring enclosures and handling means and, if not recirculated, the spent heating medium must be discharged with consequent loss. The desire for faster heating by this means tends toward higher velocities which may be seriously limited by their ability to damage delicate surfaces and by the possibility of contamination of the work by air-borne dirt.

Heating by radiation is relatively new and in spite of many kinds of applications in industry, is but little understood. The calculation of radiant heating effects is not easily reducible even to empirical relationships. In spite of these disadvantages, radiant heating is a rapidly growing industrial tool and the electrically heated metal sheath radiator brings so many degrees of freedom to any application that it not only finds itself favored in new installations, but in addition is replacing older forms of electrically heated sources in existing installations.

It was not long ago that relative cost of energy in dollars per million B.t.u. was a major factor in steering many applications away from electricity because of its high relative energy cost. However, with today's tax climate and labor rates, the lower capital cost of electrical ways of doing things, the reliability of the medium, and the uniform quality of the result frequently more than overshadow the disparity in overall gross energy costs.

FAR INFRARED VERSUS NEAR INFRARED

Far infrared is the accepted terminology for radiation in the longer wavelength, invisible portion of the electro-magnetic spectrum. It is associated with radiation temperatures from approximately 330°C. (600°F.) to approximately 810°C. (1500°F.). These temperatures correspond to peak intensity wavelengths of approximately 5 and 3 mu, respectively. In this range of wavelength, the radiation is invisible and practically all liquids and solids are opaque to it, although it is transmitted without loss by gases. It is particularly fortuitous that highly satisfactory metal sheath electric heaters can be made to operate continuously over long periods of time at approximately 810°C. This operating temperature and consequent high radiation output, together with the long wavelength combine to make a tool of great value to industry.

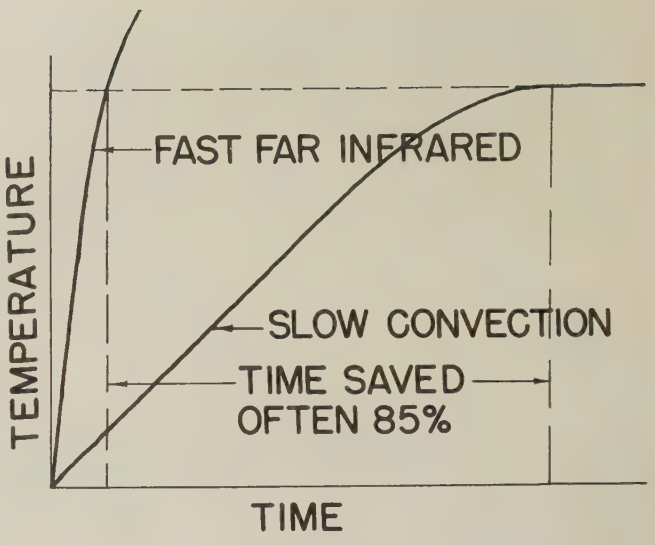

Fig. 1

One of the interesting factors promoting economy of application in radiant heating is that radiation falling on a surface opaque to it is immediately transformed into heat. The surface (and by thermal conduction, the internal body) is heated above the surrounding ambient. This peculiar ability of being able to heat the work above the surrounding ambient without heating the ambient is an important factor in contributing to the economy and effectiveness of radiant heating applications.

EQUIPMENT FORMS

Electric far infrared radiant heating using the metal sheath heater involves fortuitous relationships which combine in bringing some interesting values to the paper industry. The metal sheath heater operating at 810°C. (1500°F.) is capable of long-hour continuous operation in any atmosphere or position. It resists mechanical damage, can be made in lengths up to 30 ft., and bent into practically any configuration. Radiation at this wavelength is relatively insensitive to pigmentation which means that all colors are heated with practically equal speed.

Radiant sources are today made in a number of standard sizes in the single element and double element designs shown

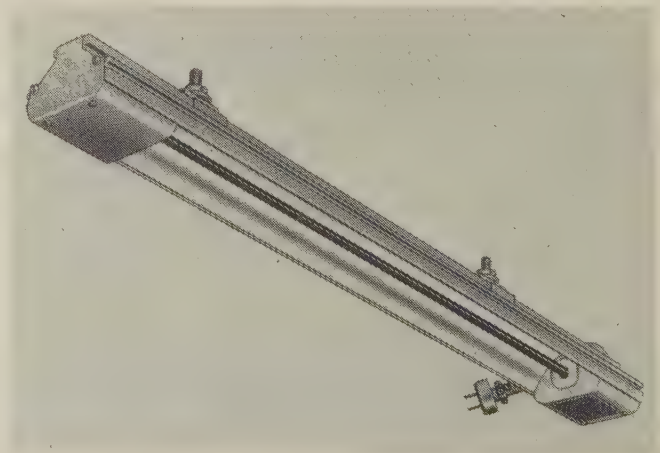

Fig. 2

W. L. THOMSON, Manager, Radiant Heater Div., Edwin L. Wiegand Co., Pittsburgh, Pa.; S. DALHEIM, Wiegand Fellow (1954–1955); and V. T. STANNETT, State University of New York, College of Forestry, Syracuse, N. Y.

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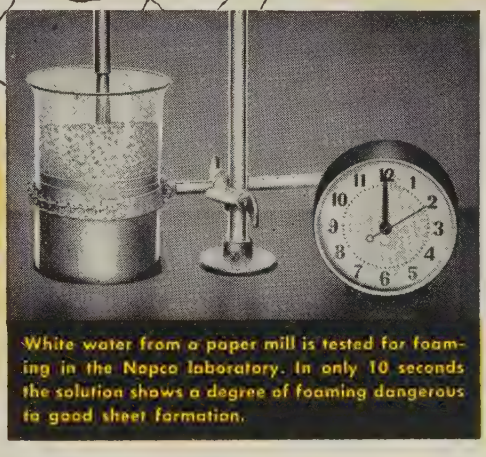
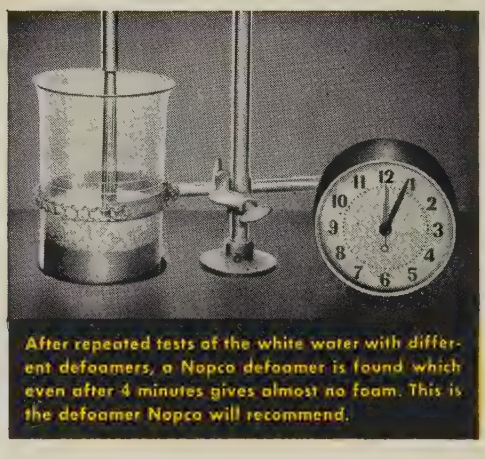


White water from a paper mill is tested for foaming in the Nopco laboratory. In only 10 seconds the solution shows a degree of foaming dangerous to good sheet formation.



After repeated tests of the white water with different defoamers, a Nopco defoamer is found which even after 4 minutes gives almost no foam. This is the defoamer Nopco will recommend.

Nopco well knows that an excellent defoamer in one paper mill may be an indifferent performer in another. Since our aim is always to reduce foaming to the minimum under any conditions, we have set up testing techniques which in effect "bring your mill into our laboratory."

We do this by testing samples of white water from your mill, with every potentially effective defoamer—including if you like, the one you are now using. When we have finished these exhaustive and accurate tests, we *are able to determine scientifically* which defoamer will give *your* mill the best fibre distribution, fewer breaks, higher machine speeds, and improved sheet formation that is your due.

Nopco, the very first to make a chemical defoamer for the pulp and paper industries, has an unrivalled wealth of first-hand experience—and the widest variety of defoamers, both paste and liquid. Why not *make sure* you have the best possible defoamer, by consulting Nopco today?

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in Figs. 2 and 3. Tubular heaters mounted in panel form as shown in Fig. 4 are available in sizes up to 2 ft. by $5^1/_2$ ft. and at a standard input intensity of 2.7 kw. per sq. ft.

In forms such as these, far infrared without objectionable combustion effects can be brought into any application where there is room for the equipment. All of these sources are made with regard for the importance of uniformity of radiation distribution. Hot and cold spots in proper applications are not existent. There is no requirement for ventilation, nor is there any disadvantageous glare.

APPLICATIONS IN PAPER CONVERTING

Far infrared is by no means new to the converting segment of the paper industry, where numerous and extensive applications exist. In Fig. 5, a sheet is being laminated and glue drying is accelerated by two banks of four radiant heaters mounted $5^1/_2$ in. from the web on 12-in. centers. Total capacity is 10 kw. and paper can be run at 65 f.p.m. with no sheet spoilage. Figure 6 is a view of the opposite end of this machine clearly showing the radiant heaters and the crank and chain mechanism by which they are rotated to remove heat from the sheet when it stops.

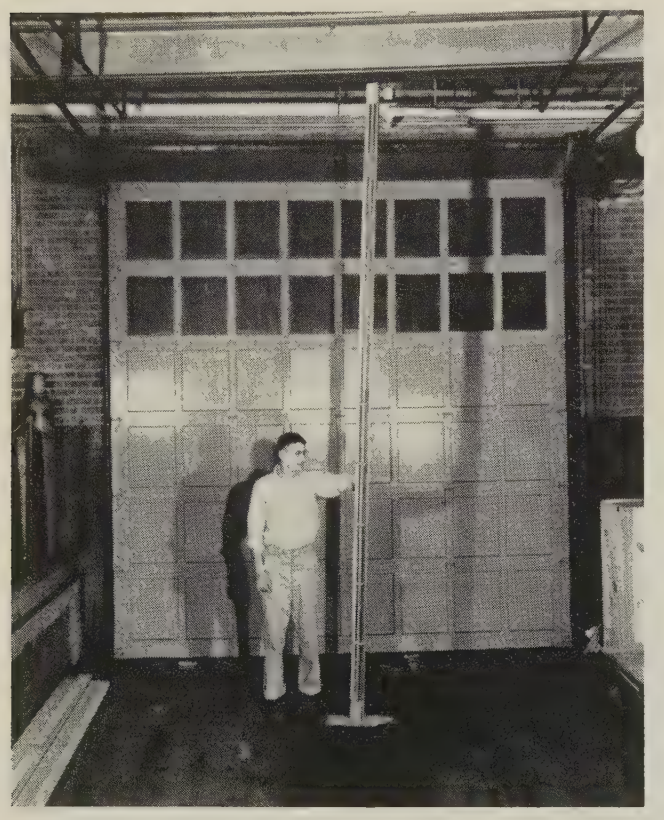


Fig. 3

In Fig. 7, radiant heaters are installed on an automatic gluing machine in the plant of a Chicago converter. Machine speed has been increased 30% and curling of the glued surfaces has been materially reduced.

In the art of extrusion laminating of polyethylene, it has been found that superior lamination results if the sheet is heated before laminating to drive out moisture and to prevent premature setting of the polyethylene. The mechanism here is to induce better penetration of the plastic between the hot fibers. After lamination, it is customary to postheat the sheet, again using radiant heat without contact for the purpose of improving the bond.

Figure 8 shows a drier in the plant of a Chicago wallpaper manufacturer. Ten metal sheath radiant heaters are installed edge to edge across the width of the sheet. There are three such banks of heaters along the length of the sheet which is handled at 87 f.p.m. with all colors being adequately dried at this speed, which represents an increase of 70% in capacity over a former infrared drying arrangement, although the present installed electrical capacity is only 80% of the previous installation.

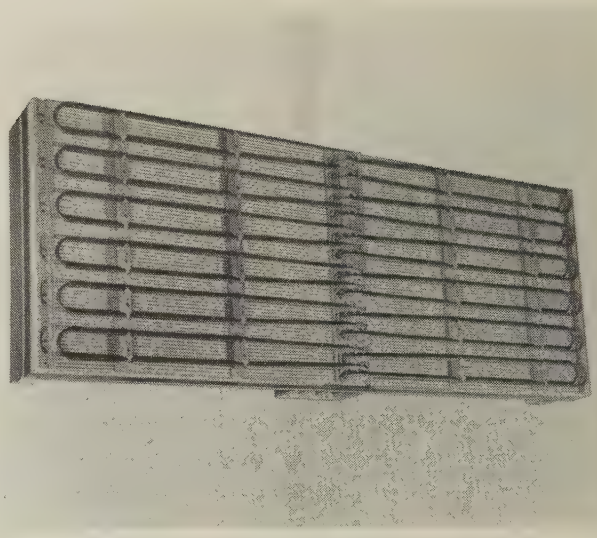


Fig. 4

PRESENT USES IN PAPERMAKING

There are several interesting aspects to applications of far infrared in papermaking. During the past year, some 20 mills and converters discovered it of value in process applications. Some of these are as large as 1000 kw. The extreme value of radiant heating in the paper industry appears to be that it can be brought into play anywhere there is room for the equipment. There is no loss between the source and the work to be heated and because paper is a fibrous material, tremendous areas of insulating boundary film surrounding fibers must be penetrated if the fiber is to be heated. Radiation of the sort under consideration passes without loss through air and most gases and is instantly transformed into heat upon contact with almost all solids and liquids. Since most solids and liquids are entirely opaque to far infrared, it is transformed into heat at their surfaces.

The increasing emphasis on coated paper and boxboard, together with a greater variety of coatings requiring heat has

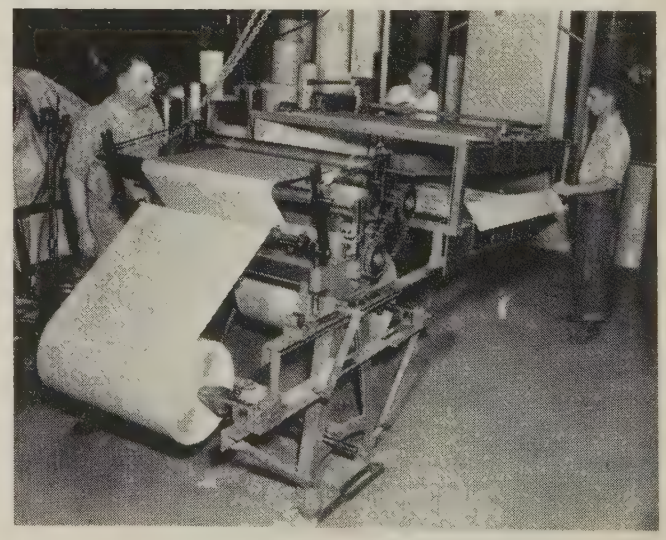
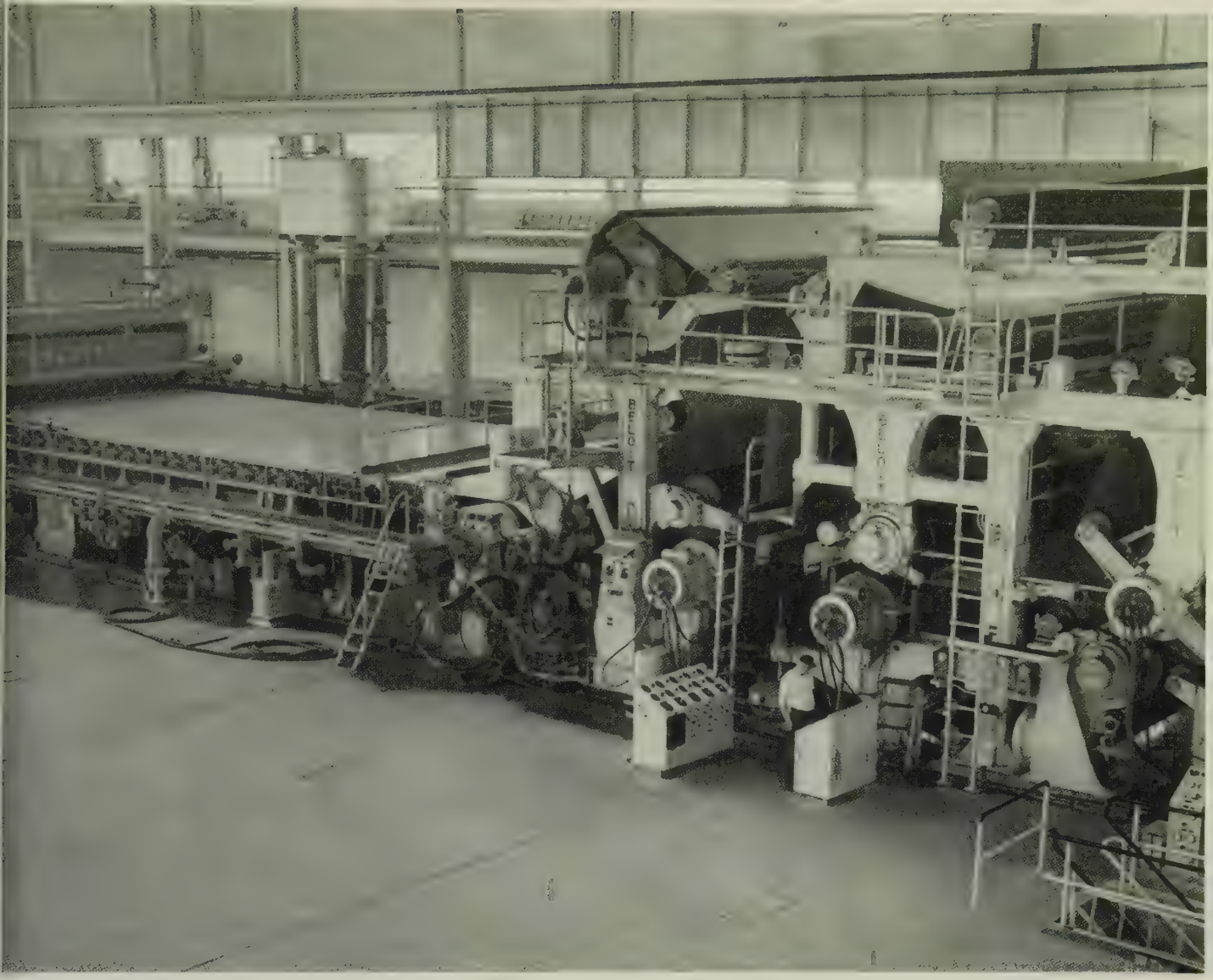


Fig. 5



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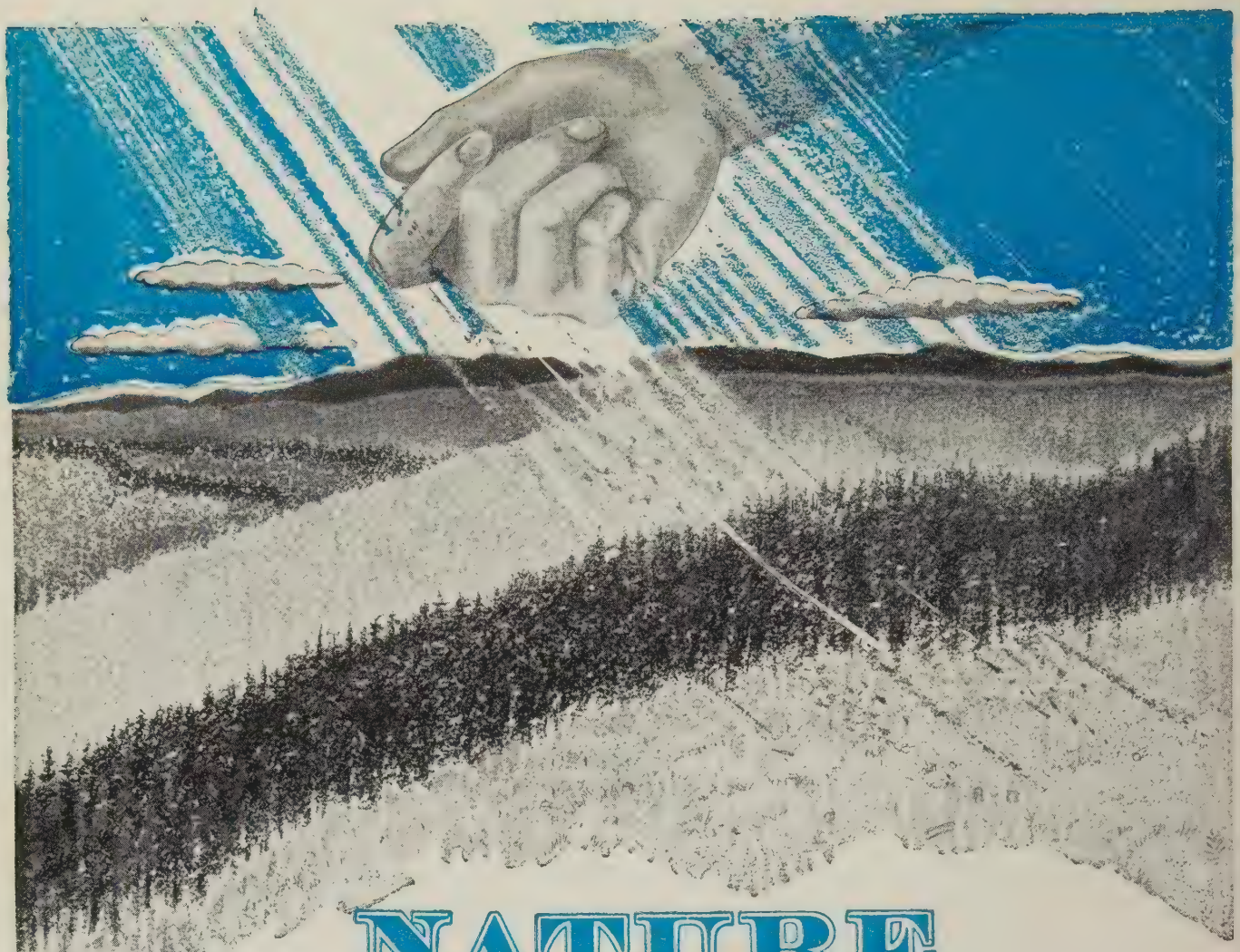

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Natural reforestation on Weyerhaeuser Timber Lands is achieved with seed supplied from blocks of trees reserved during logging and left standing to re-seed the adjacent cut-over area. This is a basic principle of Tree Farming.

Weyerhaeuser forest lands, consisting of eleven Tree Farms, are *cultivated* scientifically and intensively in line with the best possible forestry practices. Reforestation keeps pace with harvesting. Re-seeding of cut-over land *now* assures a timber crop that is sufficient and continuous.

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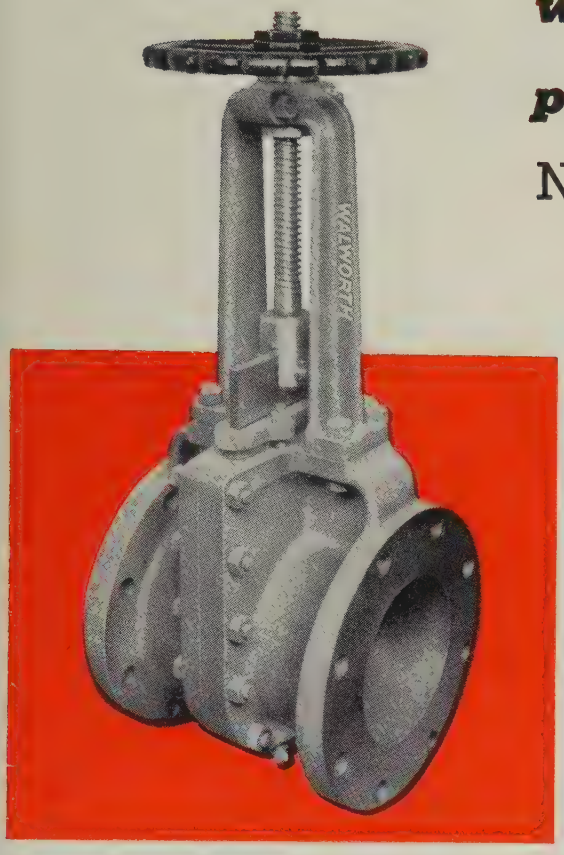

Clogproof operation makes this Walworth Gate Valve particularly suitable wherever pipelines transport pulp stock or other suspensions carrying solids or fibrous matter. There are no bonnet recesses or body obstructions to accumulate matter . . . circular ports permit full flow . . . semi-circular gate closes to a tight leakproof shutoff.

Suitable for a wide range of fluids and operating conditions, this unique valve design is available in All Bronze, Iron Body with Bronze Trim, Iron Body with Stainless Steel Trim, and All Stainless Steel construction. Handwheel, sliding-stem-and-lever, motor, and cylinder operation are available.

The complete Walworth line now includes valves and fittings for "across-the-board" use in pulp and paper mills. Gate, globe, angle, check and lubricated plug valves, as well as pipe fittings, in all conventional sizes and types. For additional technical data on the No. 757F — or any Walworth product — see your nearby Walworth Distributor or write:

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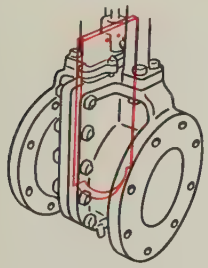
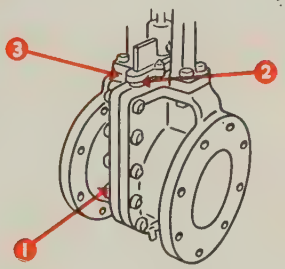
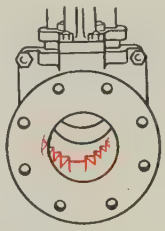


Semi-circular Shearing Gate... Sharpened, beveled edge of the gate shears through matter without touching inlet or outlet halves of the body. At point of closure a tight, leakproof shutoff occurs as the heel of the gate shearing edge wedges with a lug in the inlet half of the body. Ample gate length permits re-sharpening.



Bonnetless Design . . . 1) Two-piece body is bolted together and gasketed on a vertical centerline. 2) Stuffing box is an integral part of the body. 3) Packing and one-piece gland completely encompass gate.



Body Shearing Notches... Lower portion of the seat of the outlet half of the body is notched to better distribute the fibers of the pulp stock. This makes it easier for the gate to cut through fibrous material.

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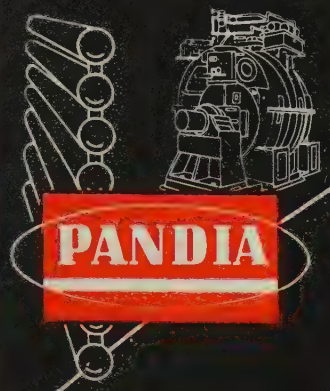
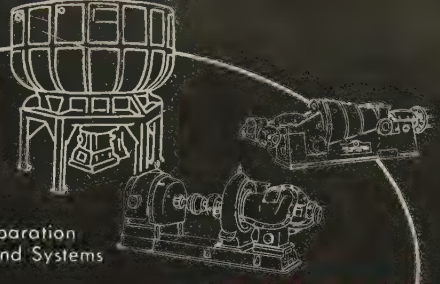


PANDIA



Stock Preparation
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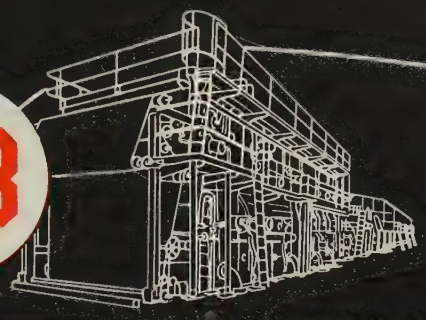
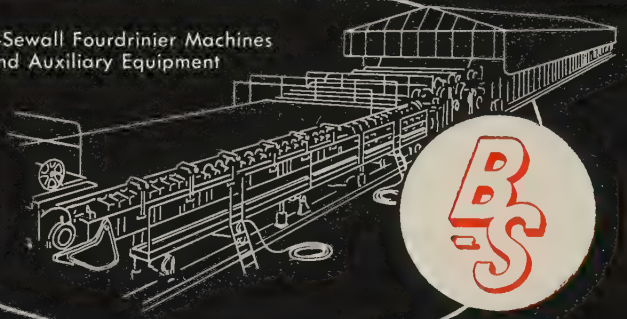


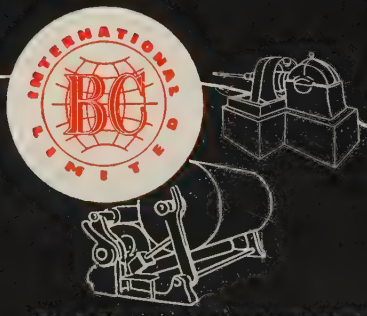
Cylinder Board Machines
and Auxiliary Equipment

Bagley-Sewall Fourdrinier Machines
and Auxiliary Equipment



Dilts

Paper and Plastic Converting Machinery



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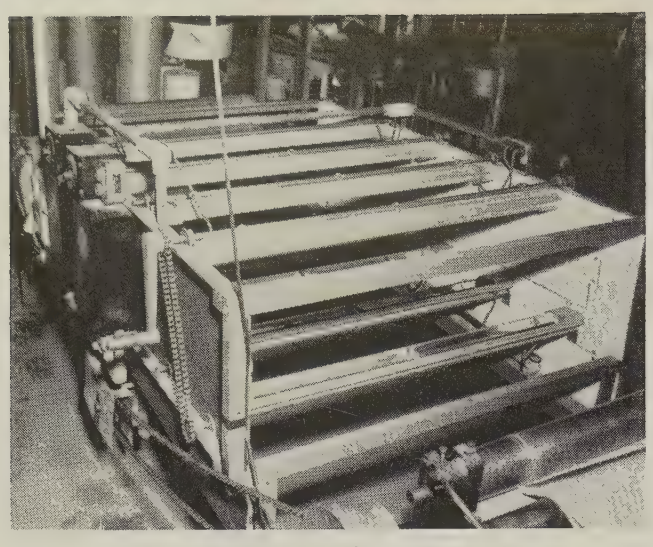

Fig. 6

Fig. 8

intensified the need for auxiliary heat in order to attain higher machine speeds. Where higher speeds are coupled with a requirement for higher curing temperature in order to obtain maximum value from the coating material saturants or additives, far infrared will afford a low-cost means of speeding up existing operations.

In a comparable industry, that of textile finishing, one installation of $1600 worth of far infrared radiant heaters gave an increase in capacity of 42% to an existing $16,000 drying range. Experiments in the textile industry now indicate that water evaporation from woven goods can be accomplished with far infrared alone at an economy of 0.345 kw.-hr. per lb. of water evaporated. It is evident from this that water evaporation using far infrared alone will probably be economical in selected instances but that greater value of far infrared will result in operations where it is desirable to increase the capacity of existing equipment.

One instance in point is that on a Connecticut Valley cylinder machine making heavy board. Here it was found that the application of 1 ft. of radiation along the length of travel on the wet end, produced the same temperature rise as one drier. Two such 1-ft. areas of radiation installed 1 ft. apart supplied the additional capacity of two driers at an economical capital and operating cost. In this instance, it was necessary to separate the radiant areas since continuous radiation for a length of 2 ft. caused the formation of steam within the sheet with consequent bursting.

In Fig. 9, polyvinyl chloride is being printed on a non-woven cotton fabric weighing dry and untreated, 13 grams per sq. yd. After printing the 44-in. wide web moving at 90 f.p.m. is given a 2-sec. cure while passing under the far-infrared radiant panel type source shown in Fig. 10. This radiant source is 36 by 48 in. along the web with total kilowatt input of 32.4.

Ventilation is provided by means of the 6-in. outlet at the top of the enclosure.

Actual power cost per square yard is $0.0003.

Diazo Coating

The three-station Diazo coater and drier shown in Fig. 11 from the unwind end and in Fig. 12 from the wind-up end, is installed at Ozalid Div., General Aniline & Film Corp., Johnson City, N. Y. The construction was developed by Ozalid and Frank W. Egan Co., Bound Brook, N. J., and installed by the latter. The far-infrared electric drying facilities consist of 72 radiant panel-type sources each 12 by 48 in. and rated 440 v., 10.8 kw., three-phase for a total installed capacity of 777.6 kw. Panels are installed in groups of six with elements 4 in. apart. In each group, three panels are facing downward, and three upward. The coated paper to be dried is passed between the radiant sources. Each group of six panels is mounted on a carriage which slides horizontally under automatic control whenever the web stops. The 48-in. panel

Fig. 7

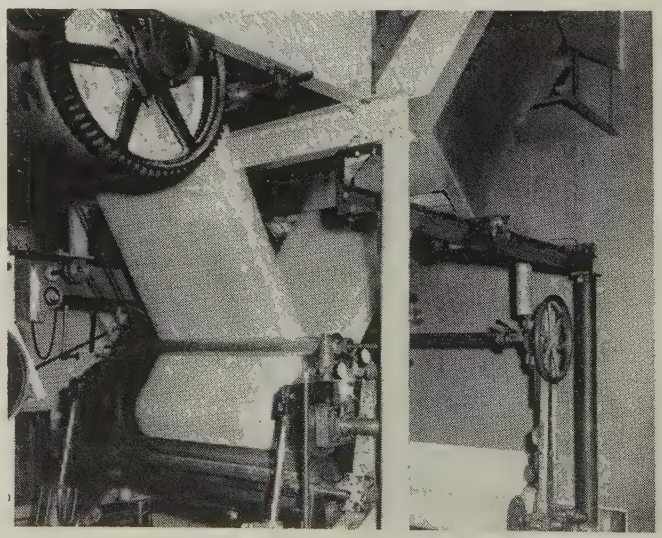

Fig. 9

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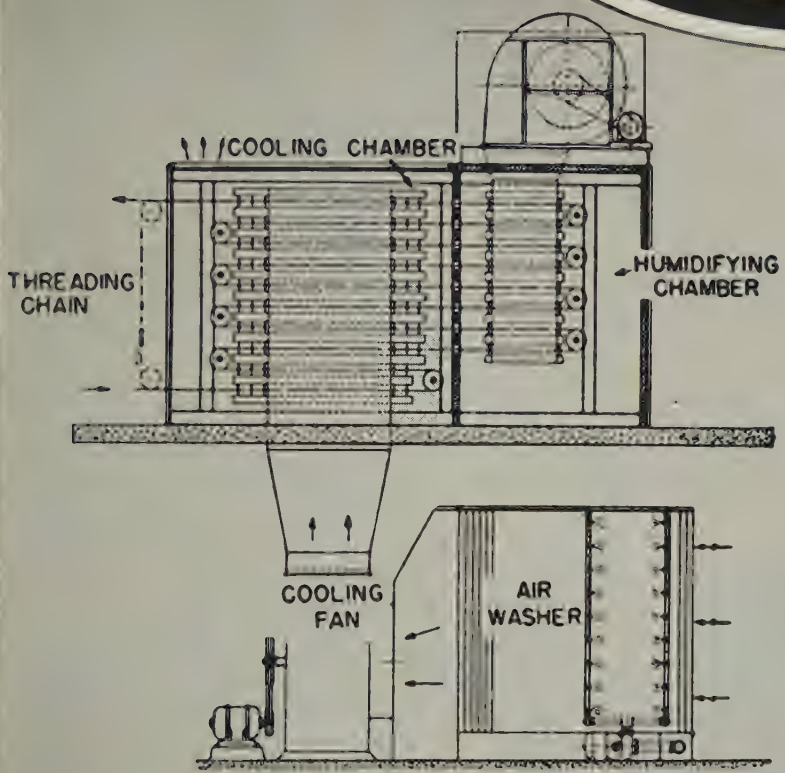

Representation of the Ross Cycle Conditioner

Write for descriptive Bulletin No. 32, giving full particulars.

Operating on a unique and new principle, the Cycle Conditioner provides these advantages:

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2. Insures greater dimensional stability.
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4. Relieves stress and strain in sheet.
5. Added water increases weight and tonnage.
6. Produces ideal base stock for multi-color printing.
7. Minimizes cockles, dimples and curling.
8. Reduces static.
9. Produces stable sheet as to moisture changes.
10. Insures greater customer satisfaction.

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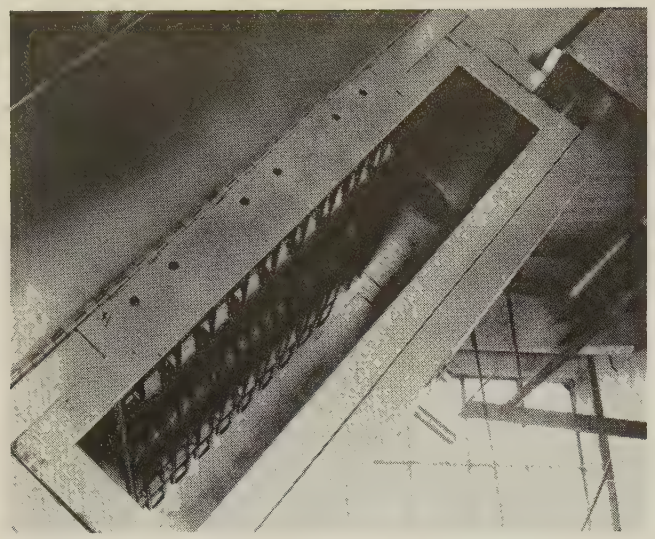


Fig. 10

width gives adequate overhang beyond the edge of the web which is 42 in. maximum width.

Arrangement of panel sources can be seen in Figs. 11, 13, and 14, the latter showing the carriage arrangement with two wheels for retracting panels. After each coating station, the paper passes under an air knife and then between the four groups of six panels each which are clearly shown in the bridge structure in Fig. 11.

This particular design of machine and drying facility was chosen because of the extremely limited space requirement. Although an air drier would have had the same length, it would have been approximately three stories high whereas the existing machine is installed under a 12-ft. ceiling.

The tentative trial capacity of this machine is indicated at 54,000 sq. ft. per hr. with every indication that as experience in operation is accumulated, this capacity will be increased materially.

CURING OF SATURANTS AND ADDITIVES

The increasing emphasis on wet strength through the use of thermosetting resins such as melamine and urea makes

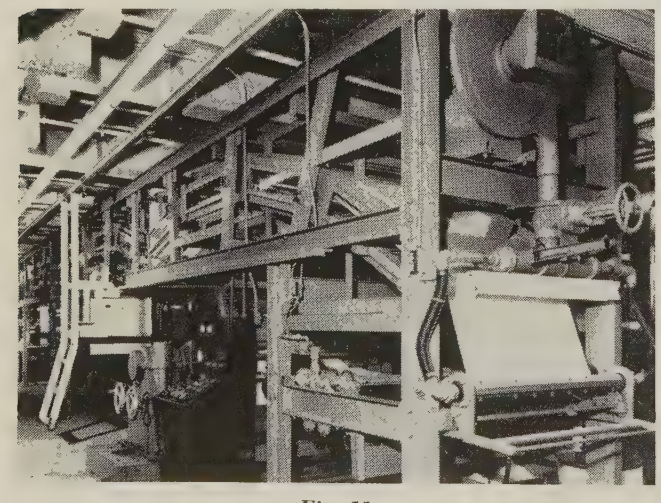


Fig. 11

mandatory the rapid curing of these resins in the paper. Only partial cure takes place on the conventional paper machine driers and several weeks of further cure under storage conditions are necessary for significant increases in wet strength. Rarely is the maximum cure obtained under normal conditions. One remedy for this situation is the suitable application of radiant heat, possibly entailing the relocation of the paper machine reel to give adequate space. If such a course is decided upon, it is evident that the highest possible radiation intensity will be most desirable and that complete uniformity of radiation intensity is a must if uniform cure across the sheet is to be obtained.

Table I. Development of Dry Burst Strength of Kraft

Paper saturated with nitrile rubber (14% as dry pulp weight)

Exposure time to reach dry strength of	*Air circulating oven* 100°C.	180°C.	*Far infrared*[a]
32 psi. (initial)	....	...	...
38 psi.	4,500 sec.	250 sec.	2 sec.
44 psi.	11,400 sec.	630 sec.	6 sec.

[a] Heating elements 5 in. from work (40 watts per sq. in. of heating surface at source).

Large quantities of rubber and plastic emulsion treated papers are being produced for use in gasketing materials, masking tape backings, shoe innersoles, and many other uses. It has been shown that a heat "cure" is necessary to bring about the maximum strength properties in heated papers of this kind, whether produced in the beater or by saturation. The conditions of cure necessary to develop maximum properties are far beyond the resources of the conventional paper machine drier. A program of research is currently under way at the College of Forestry to determine the best radiation conditions to effect the necessary cure and to compare these results with convection-type heating. This work will be reported in full in a later communication, but some initial results are presented in Tables I and II. It can be seen that high degrees of cure can be effected in very short times of exposure with the use of far infrared radiant heaters. Such heat must be applied with caution to avoid simultaneous cure and degradation spoiling the optimum strength properties.

Using another parallel from the textile industry, textile resin finishing carried out on steam filled dry cans gives resin cures of the order of 40 to 50%. The same resins cured with electric radiant heat show 70 to 90% complete polymerization with consequent highly satisfactory savings in the amount of resin required to produce a given finish.

A parallel situation results when surface coating applications are made on the paper machine at points which do not permit the use of the entire drier section.

SETTING COATINGS

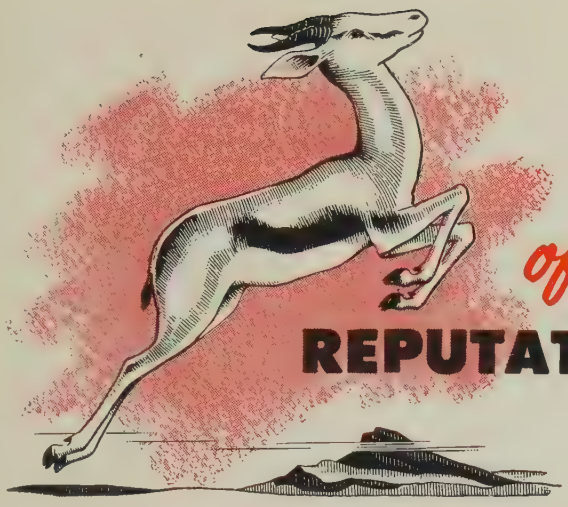
On-machine coating is probably productive of as many problems as any other phase of papermaking if double coating is being done. With a sufficiently long draw between coater and the first drier, radiant heat can be a means by which picking is eliminated. The problem is only that of setting the coating, rather than that of completely drying it. In such an application, in order to take advantage of convection effects, it is most desirable to move the sheet downward in the first draw after the coater. Since this is manifestly difficult to impossible, the next best solution is to run the sheet vertically upward, radiating both sides of it. Although

Table II. Development of Wet Burst Strength of Kraft

Paper saturated with nitrile rubber (14% as dry pulp wet)

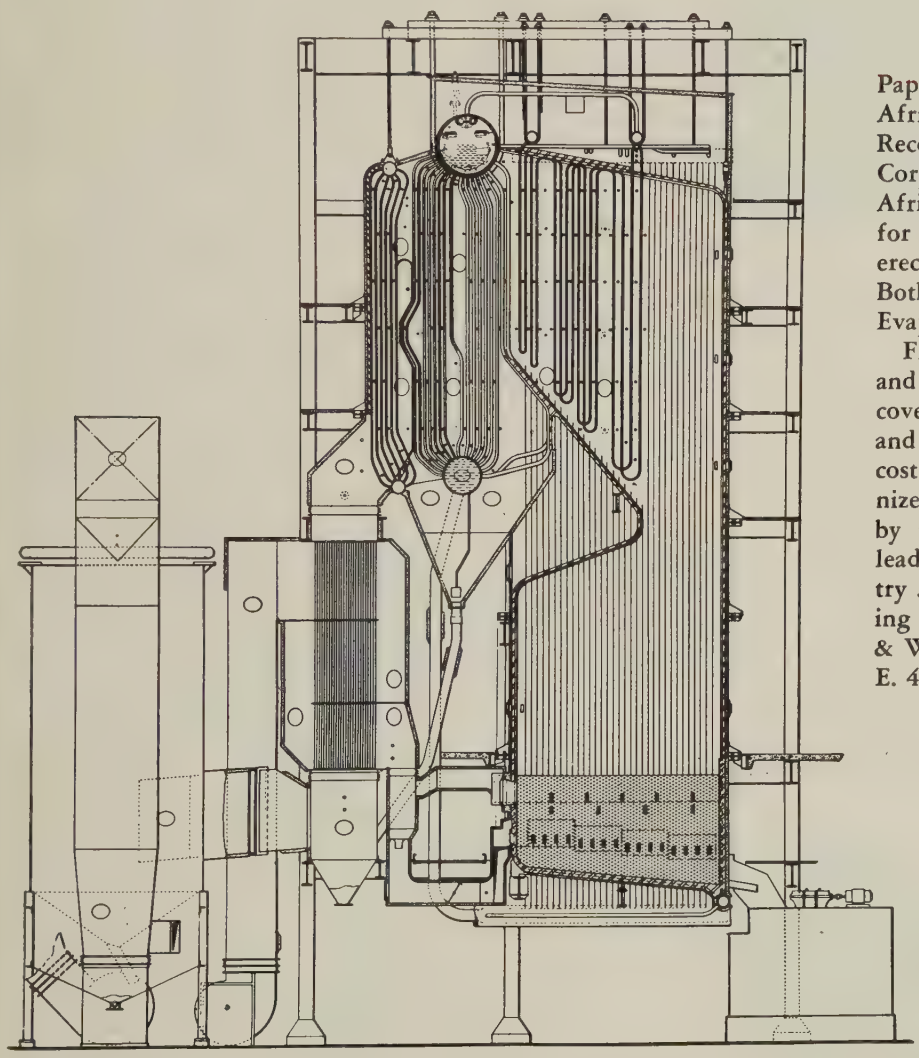
Exposure time to reach wet strength of	*Air circulating oven* 100°C.	180°C.	*Far infrared*[a]
30%	8,100 sec.	80 sec.	4 sec.
50%	16,260 sec.	370 sec.	5.6 sec.
70%	More than 20,000 sec.	1000 sec.	6.4 sec.

[a] Heating elements 5 in. from work (40 watts per sq. in. of heating surface at source).



The SPRINGBOK, national emblem of South Africa.

# of B&W Recovery Units REPUTATION GOES A LONG WAY ...to South Africa



200-Ton B&W Recovery Unit with B&W Cyclone Evaporator for Outdoor Installation in Zululand.

Paper Industries, Ltd. of Springs, South Africa, have been operating a 75-ton B&W Recovery Unit for several years. Union Corporation, Ltd. of Zululand, South Africa, have ordered a 200-ton B&W Unit for outdoor installation; it is now being erected. This represents a repeat order. Both units will have B&W Cyclone Evaporators.

From Oregon to Florida, to Zululand and Finland, the reputation of B&W Recovery Units for highly efficient chemical and heat recovery, reliability, and low-cost operation and maintenance, is recognized. It is a reputation firmly established by the performance of B&W Units in leading mills throughout the paper industry . . . a reputation that is rapidly reaching world-wide proportions. The Babcock & Wilcox Company, Boiler Division, 161 E. 42nd Street, New York 17, N. Y.

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P-771

this is an unconventional mode of sheet handling in papermaking, it seems to be an only adequate answer, especially where higher machine speeds, and therefore, longer radiation paths must be considered.

In setting coatings, exposure times ranging from 0.8 to 2.0 sec. are reported as being sufficient to prevent picking on the drier.

Under this heading come not only the largest, but the most numerous of the far infrared applications to date. They

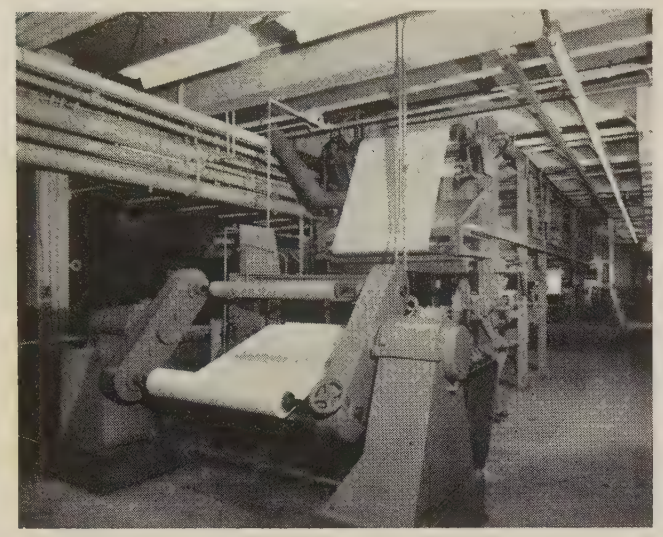

Fig. 12

promise to increase tremendously as greater knowledge of such applications becomes available, and the trend toward higher machine speeds continues.

POSSIBLE FUTURE APPLICATIONS

In the literature of the art of papermaking, there appear many references to problems of drying uniformly across the sheet. Lack of uniformity across the sheet will cause insurmountable problems in poor adhesion and warping when making corrugated board. It would seem that here radiant heat properly applied might be instrumental in promoting evenness in drying across the sheet.

On the paper machine, it is evident that the removal of the last few per cent of moisture from the sheet is accomplished with increasing difficulty as the paper becomes dryer. Since the mechanism of supplying latent heat of vaporization in order to produce evaporation is partly performed by the drier felt, it must be evident that improved performance should result from a hotter felt.

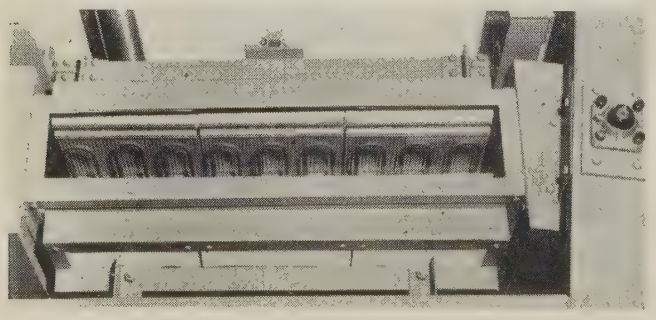

Fig. 13

The fact that felt manufacturers are using far infrared to assist in drying newly made felts after washing, leads to the thought that radiant heating may be a possible answer to higher machine speeds if low drier felt temperature is a limiting factor.

Another possible direction for research in the application of electric radiant heat in the paper industry will be that of reduction of cost of drier section of the paper machine. It is currently understood that cost of drying is at least 50%, and possibly 70% of the total cost of the paper machine. Any

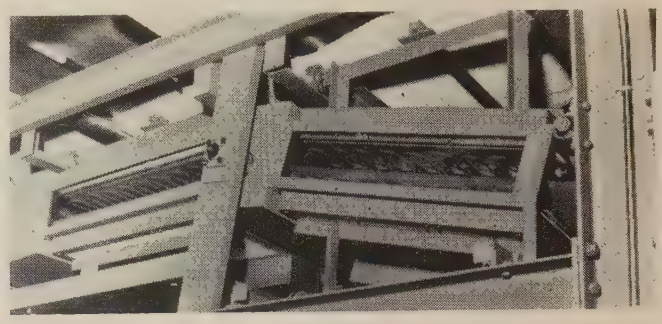

Fig. 14

possible reduction of this cost will be the means of effecting very substantial capital savings and possibly new and useful qualities in the paper produced.

On the dry end of the paper machine where higher sheet temperatures than are available with current steam pressures are desirable to promote drying, far infrared should prove an economical means of obtaining such sheet temperatures with minimum expenditure.

As greater feeling for electric radiant heating develops in the industry, a wide variety of possible applications will suggest themselves. Among these, will be the possibility of development of higher paper strength, due to drying without restraint. This infers investigation of other than steam-heated cylinder drying methods, and the availability of larger and larger supplies of low cost electric power. Such supplies seem to be nearing reality through the medium of the gas turbine which brings low cost, high efficiency, electric power generating capacity to areas where natural gas is available.

ENGINEERING FUTURE APPLICATIONS

Although the use of radiant heat is old in paper converting and other industries, it is relatively new in paper mills. It is so new in fact, that adequate application information is not available at the time this paper is being written, although a number of mills have installations which are in operation or under construction. As need arises for non-contact heating and the radiant means comes up for consideration there are always the questions of what radiant intensity and what time of exposure will produce what result. Many an application has been discarded as impractical when attacked from the theoretical angle and an answer obtained on the slide rule. A later laboratory evaluation may show such an application to be highly practical. The chief factor which cannot be adequately evaluated is that of reflectivity of the surface on which the radiation falls. High reflectivity rejects more radiation with consequent reduction in heating effect. Unfortunately, our eyes are not of value in guiding us to a correct conclusion for the reason that we are not dealing in visible wavelengths. Surfaces which are good reflectors of visible wavelengths may or may not be good reflectors of far infrared. For this reason, laboratory determination or sampling is the only reliable way to engineer radiant heating applications unless prior experience is available. Such evaluations are usually easily made even in high speed processes, such as papermaking, in which the accuracy of time determination becomes of greatest importance. A little experience produces considerable feeling on this score, and problems of this sort will be of minimum concern to the papermaker.

Received Dec. 1, 1954. Presented at the 40th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21–24, 1955.

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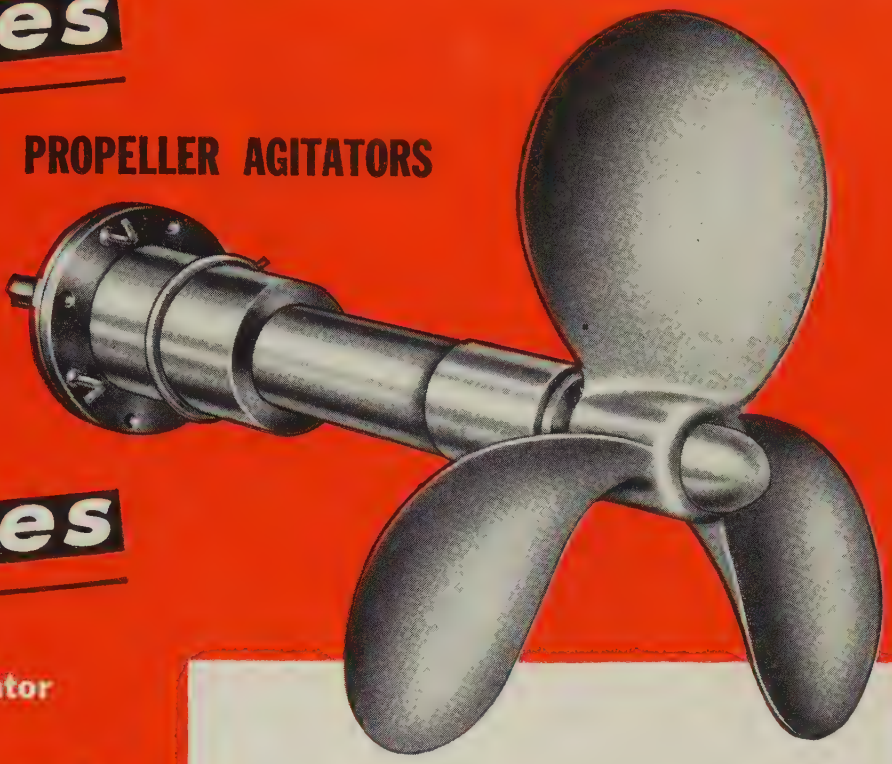

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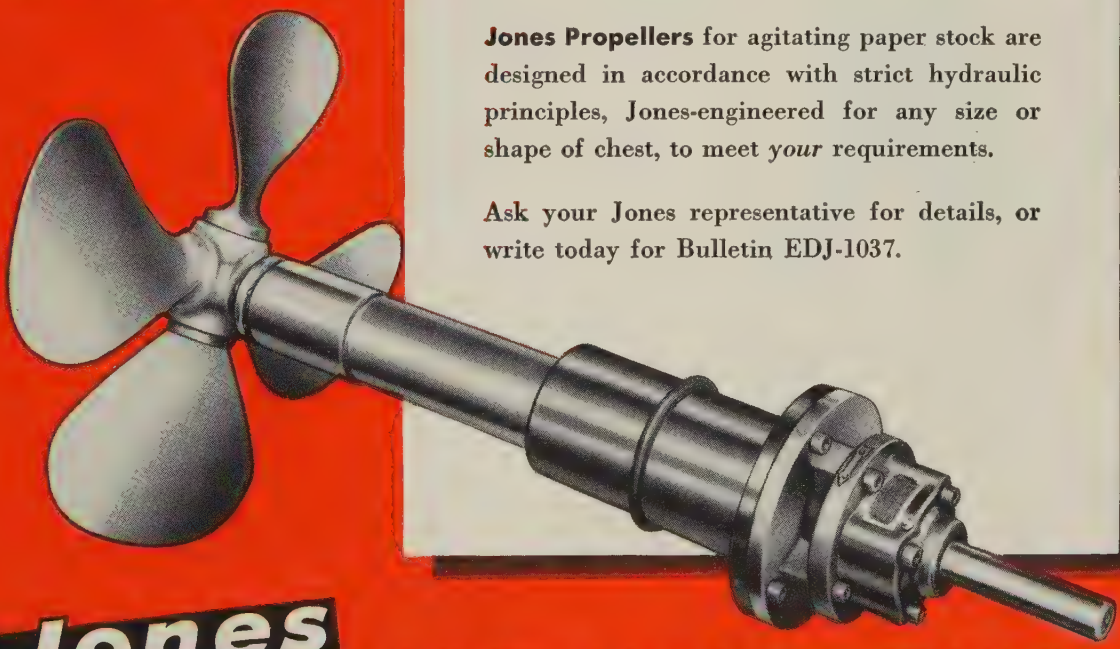

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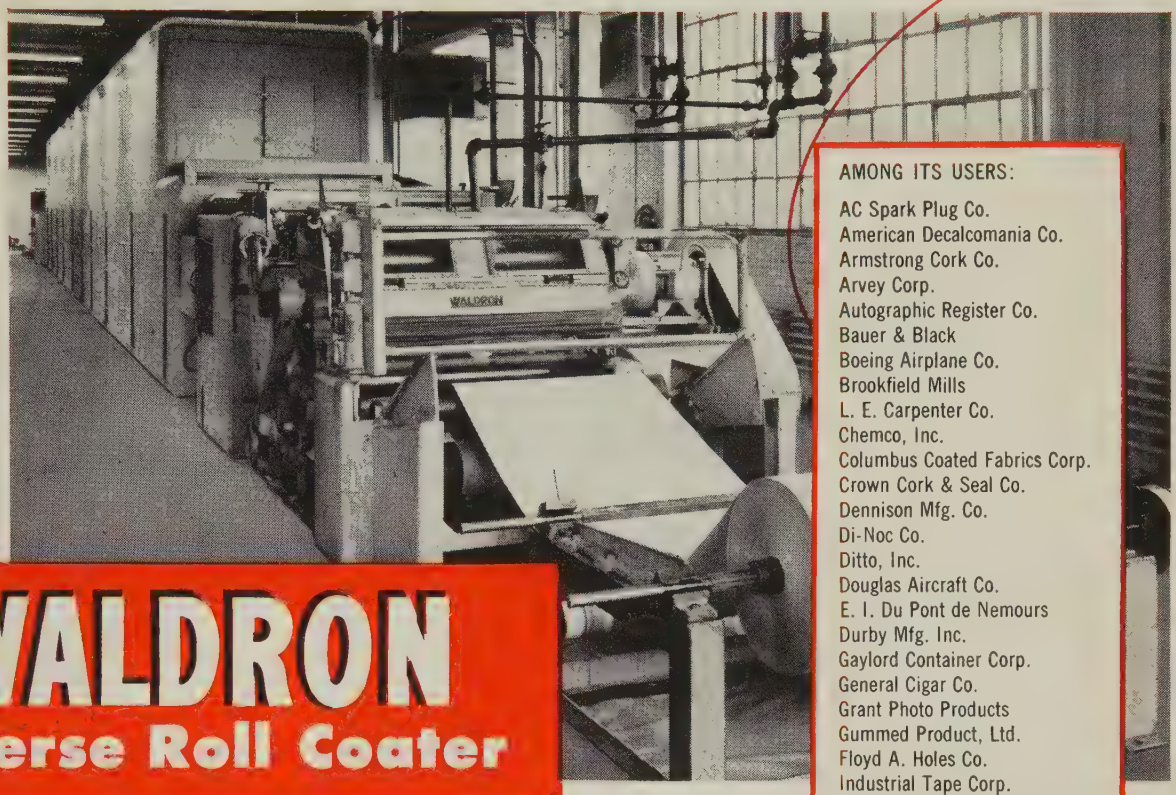

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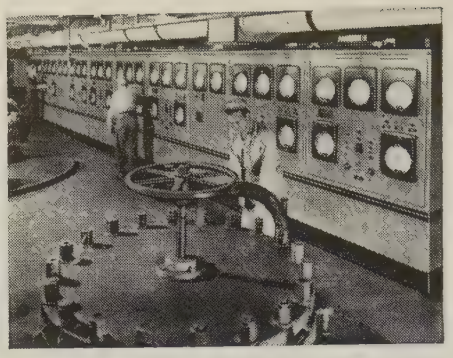

Sulphite Pulp Digester Control
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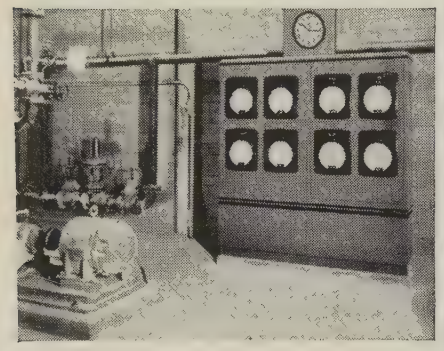

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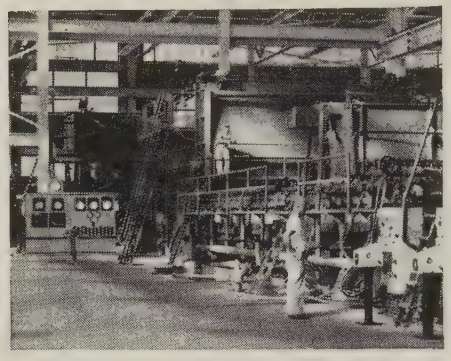

Paper Machine Wet End Control
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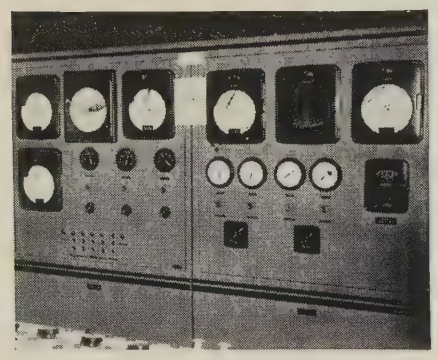

Pulp Drying Control
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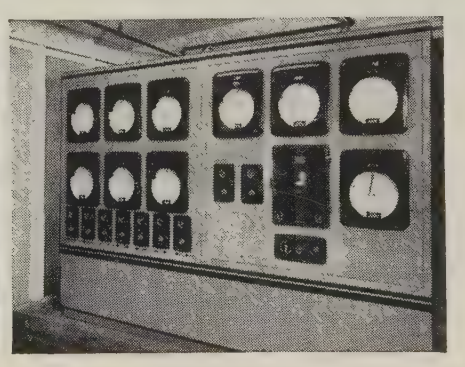

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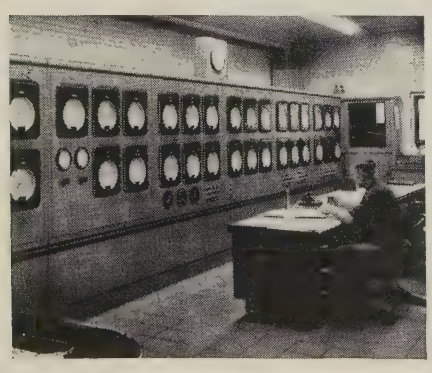

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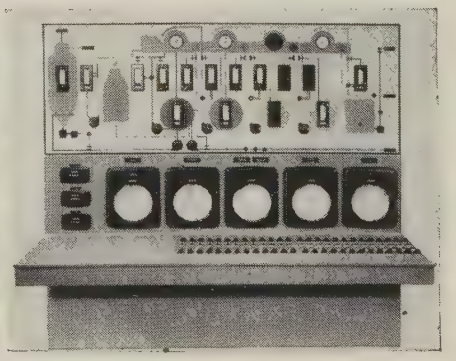

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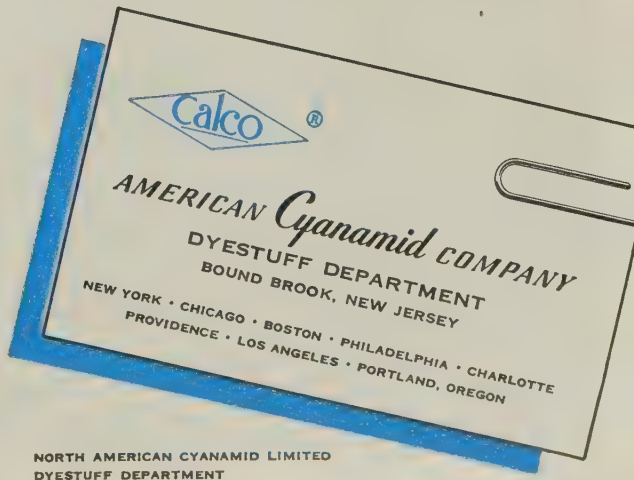
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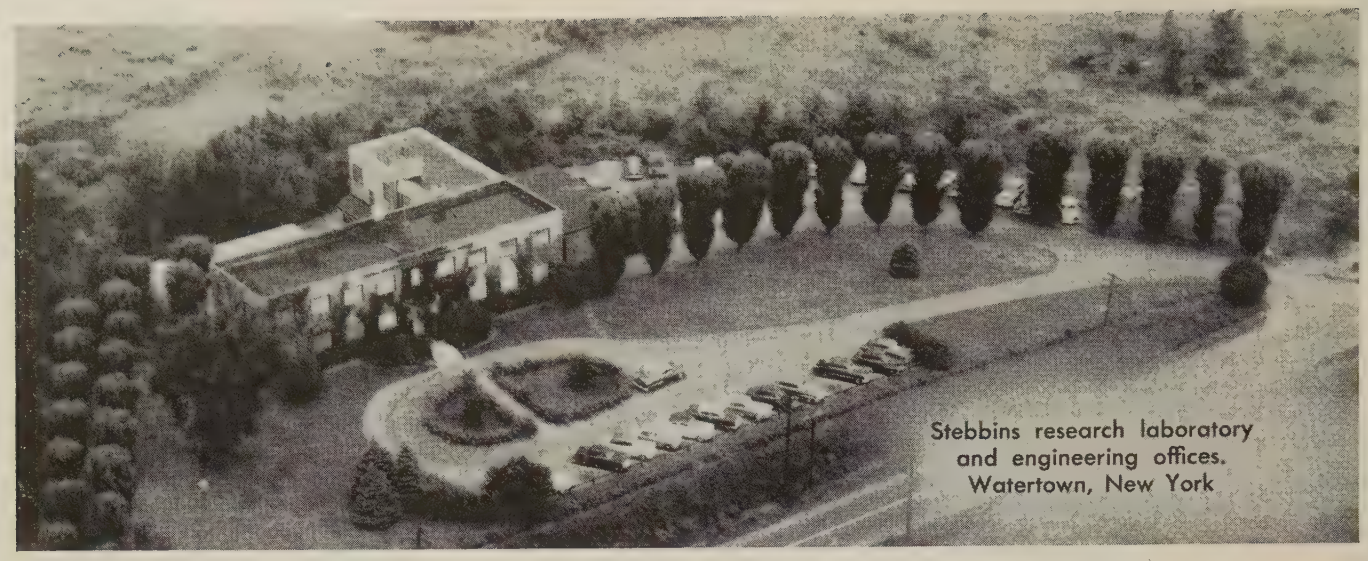

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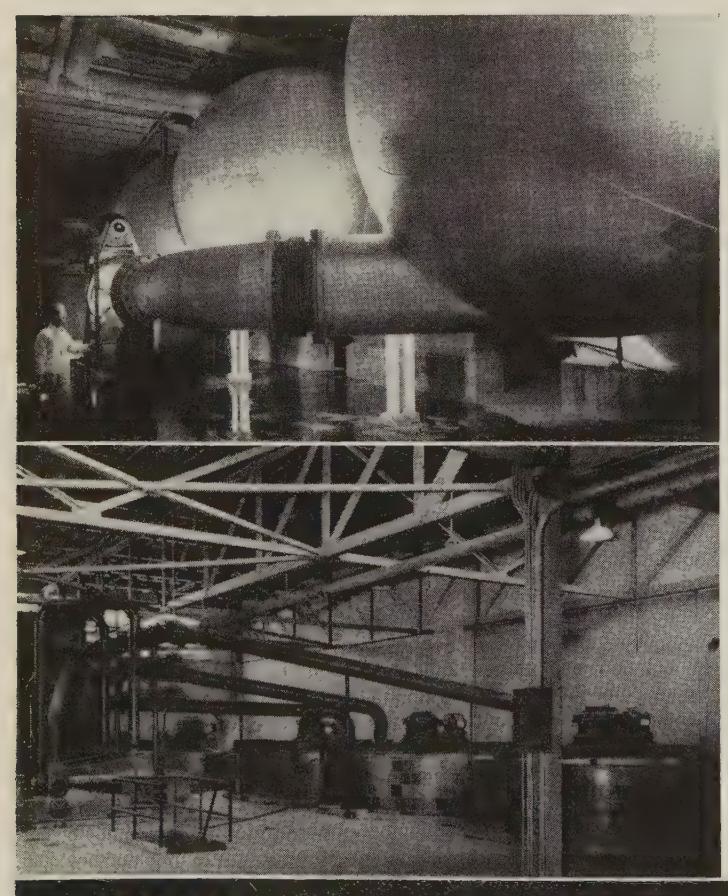

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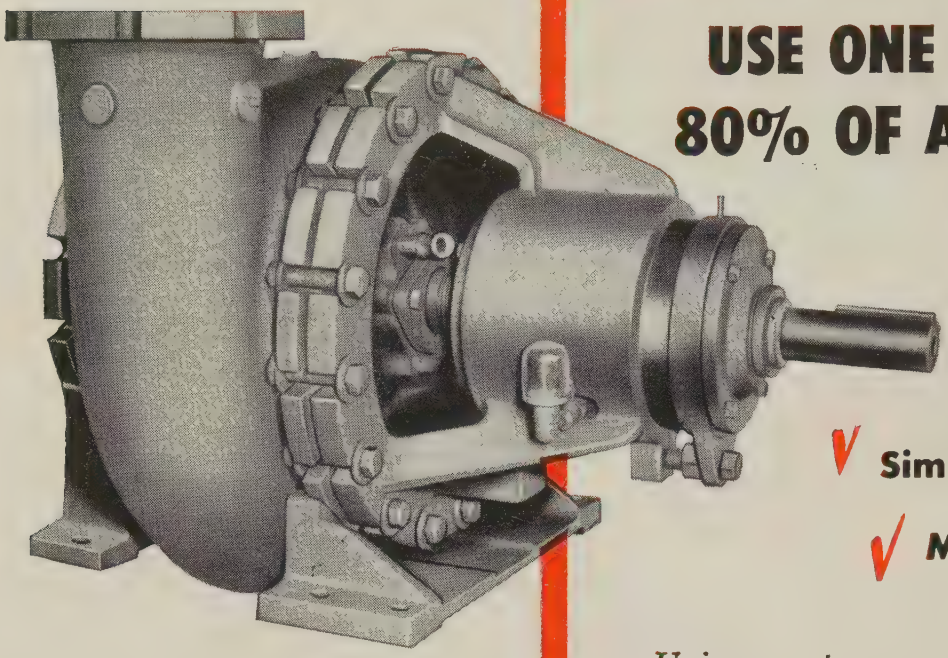

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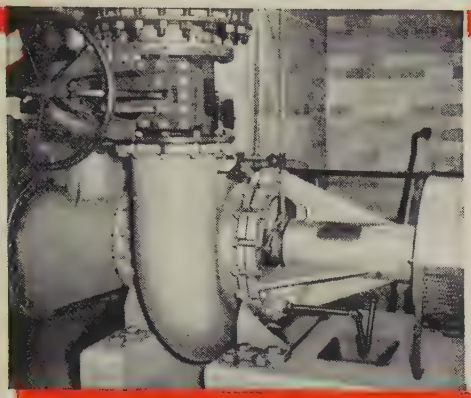
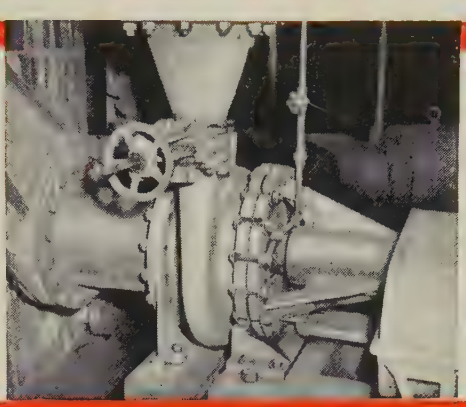
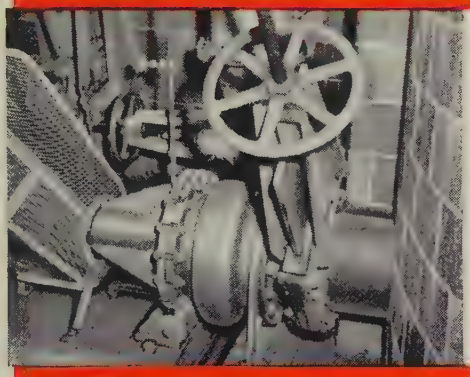


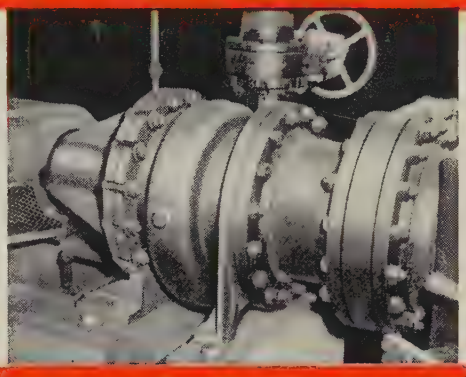
Type PWD 16 by 14 all-bronze pump handling 0.7% stock from bull screens.



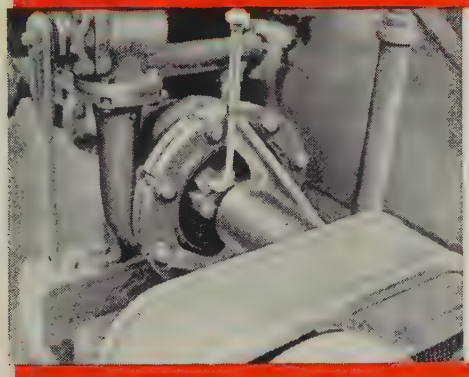
Type PWG 16 by 4 cast iron bronze-fitted pump handling 4.4% stock (heaviest in the mill) to pulp dryer.



Type PWG 16 by 6 cast iron bronze-fitted pump handling 4.0% screened stock to pulp dryer machine chest.



Type PWGOR 16 by 6 nickel cast iron blow tank stock pump handling 3.5% stock. This pump equipped with open impeller.



Type PWI 4 by 3 316 stainless-steel pump handling 1.1 specific gravity milk of lime.

Type LSC 30 by 24 bronze fan pump handling 0.6% stock to inlet box. This is one of the few stock, water or liquor pumps in the mill not of the Type PW design.

Type PWH 5 by 4 *Ni-Resist* pump handling 1.3 specific gravity concentrated black liquor to precipitating tank.

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Water Supply and Waste Effluent Disposal as Factors in Locating Pulp and Paper Mills

JULIUS GRANT

From the earliest days of papermaking a plentiful supply of water of good quality has been the principal factor in determining the site of a paper mill. The advent of machine-made papers and later of pulp manufacture on a large scale, intensified this dependence on water, at any rate from a quantitative point of view. Modern methods of water treatment have to some extent enabled water to be used for pulp and paper manufacture which in the past would have been regarded as unsuitable. The same factors have, however, automatically created a third and very important consideration, namely the problem of the disposal of the waste effluent waters from the mill.

These three important factors, namely the quantity and quality of the water and the disposal of the effluent, serve conveniently therefore for the headings under which the author proposes to deal with his subject.

QUANTITY OF WATER REQUIRED

It is not possible to generalize as to the amount of water and the standard of purity required for the manufacture of pulp and paper. Much will depend on the nature of the product to be made. However, it is as well to err, if at all, on the high side in assessing the likely requirements of the mill, as even under the best conditions water shortages are more common than surpluses. Consequently the author prefers to submit the following requirements per ton of finished product:

Manufacture of unbleached chemical pulp	160 cu. m.
Manufacture of bleached chemical pulp	180 cu. m.
Manufacture of paper from pulp	210 cu. m.
Integrated manufacture of paper and pulp	360 cu. m.

Deviations from the figures given above can arise from a number of causes. Thus in the manufacture of unbleached pulp, the sulphite process will require rather more water than the sulphate process. Similarly the number of bleaching stages will determine the water requirement for the manufacture of bleached pulps.

In general, the above figures include the water required for raising steam both for process work and for the generation of the electrical power required by the respective processes. Consequently, where electrical power is obtained from an outside source (e.g., from a hydroelectric installation), they will be correspondingly reduced. However, they do not include condenser-cooling water used by steam turbines. Unless its temperature involves any objection this, as a rule, can be cooled, returned to its source, and re-used; or else used for process work.

The above figures also allow for the recovery of a reasonable proportion of the process water, e.g., as back-water. This proportion will, however, vary considerably according to the type of mill. Thus, in the preparation of pulp, and particularly of unbleached pulp, this proportion is reduced considerably. The black liquor from the digesters, for instance, contains a large proportion of soluble matter which cannot be removed, so that the liquors must be sent to waste and the water lost. Even when an alkaline process is used and the liquors go to the recovery plant, much of the actual water present is lost by evaporation. Washings from the green stock also pass out the system. Short-fibered materials such as straw and bagasse, contain a high proportion of fine fiber debris and associated plant structures, many of them in a colloidal suspension, and therefore only removable with difficulty or at some expense.

A certain amount of recovery of water is sometimes possible from the bleaching plant, especially from the last stages of washing. However, it must always be remembered that the basic principle of the pulping operation (and this operation includes digestion, washing, screening, and also bleaching where necessary), is the removal of the nonfibrous cellulosic and other constituents of the plant. Since this is done by rendering them soluble and/or washing them out, it is apparent that the re-use of the liquors or washings is contrary to the above-mentioned general principle.

The greatest measure of recovery of water arises, of course, at the papermaking stages of manufacture in the cases of the integrated mills. Here again however, the extent to which recovery can be effected varies according to circumstances, and in particular according to the nature of the papers being made. As is well known, long runs of the same type of paper with few changes and a minimum of breaks favor a closed back-water system (e.g., in a newsprint mill). In such cases the average water requirements set out above may well be on the high side. Frequent changes have the reverse effect. Changes of color, or even of shade, create particular difficulties for reasons which are familiar to every papermaker.

The methods of recovering back-water are well known and in any case are outside the scope of this paper. Experience has shown, however, that a useful axiom in a mill having several paper machines running on different types of paper is that each machine should have a self-contained white water system, and so far as possible should carry its own white water usage. The latter is frequently not completely possible, even where each machine has its own saveall, and there is often a surplus of white water which is sent to one or more back-water towers which are usually common to several machines. In an integrated mill such surplus back-water can be turned to good advantage. Thus it can be taken back to the pulp preparation plant and used for washing pulp if relatively pure; or if colored, for instance, it can be used for filling digesters. There is therefore seldom any excuse for sending back-water to the effluent in such a mill. This point is of treble importance, namely from the points of view of water economy, fiber recovery, and reducing the effluent discharge.

Having decided, in the light of the above considerations, how much water is likely to be required for the mill, the problem arises how to find it. It is a safe principle to set as a target of quantity an amount exceeding the appropriate figure as given above by at least 10%. Quite apart from this, of course, due allowance should be made for any future expansion envisaged, but in any case water is one of the most important raw materials of the pulp or paper mill, and no site should be chosen which can provide it only in bare sufficiency.

In the great majority of cases the water will come from one or more of three sources, namely, a river, a lake, or wells. Personally, the author considers it highly dangerous to recommend a site near to or on which all the water needed cannot be *seen* at all times of the year, including exceptional seasons. For this reason he is very chary of wells, and particularly skeptical of local advice concerning them. One is so frequently told that "there is plenty of water underground" by local people whose standard of quantities is measured by existing local usages. They may well be giving this information in perfectly good faith, but without any conception of what the 650 cubic meters per hour required by (say) a mill making 50 tons per day of paper from its own pulp really means.

Where there is no alternative to well water trial borings are a possibility. However, these too have their limitations and difficulties. Thus wells are often notoriously fickle, and may run dry or at low output after a period of use. They may also rob the underground supplies of neighboring

Julius Grant, Director, Pulp and Paper Research Co., Ltd., London, England.

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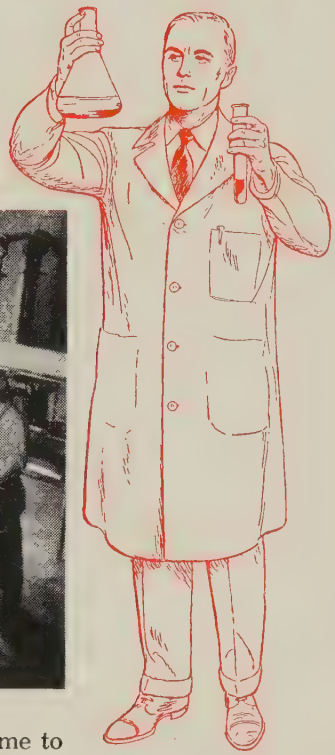

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existing wells, thus possibly leading to litigation. Conversely, other wells sunk subsequently in the locality may rob them after a time. Added to these risks is the fact that trial borings are expensive, and may not be successful and moreover, since one would not normally purchase the land before the trial borings are made, there is always the probability that the price will soar if they are successful.

The author would not like the above to be taken as a complete condemnation of the use of well water for pulp and paper mills. It is however necessary to tread cautiously. A good geologist, preferably a local man, can be most helpful in the initial stages, and the author has seen some remarkable achievements from the much-scorned water diviner. The difficulty often is to find a genuine one; the man who only takes payment if he gets results is usually reliable, but not very common! Many mills run on well water and have done so for many years, and generally speaking they have the great advantage of a supply which is both good and constant in quality.

Of the two alternative visible sources of water the author prefers the lake, especially in countries where there are well-defined wet and dry periods or seasons. In such cases the lake acts as a buffer between these extremes, filling up during the rains and gradually emptying during the dry periods. The large volume of water has the further advantage that it serves as a huge tank, so that any fine suspended matter has a chance to settle out. The composition of the water therefore remains reasonably constant throughout the year. Special advantages arise from the use of water from artificial lakes formed in mountainous areas as reservoirs for town water supplies, or in connection with hydroelectric schemes. Such water is usually relatively free from suspended matter, and, owing to the precipitation of atmospheric moisture which occurs at high altitudes in most parts of the world, it is not affected by general drought conditions. The mill itself does not necessarily have to be located near the lake. The water can be piped by gravity quite long distances along the valley at the base of the dam, and in some cases the mill has been conveniently located so that it can take advantage both of the water from a hydroelectric plant after it has passed through the turbines, and of the cheap electrical power so generated.

Rivers, a frequent source of water supply, call for little comment as regards quantity. It is, however, very important when choosing a site to obtain full statistical information as to the flows at all times of the year for a period of at least 10 years previously. In some parts of the world the variations between rainy and drought conditions are astonishingly wide, and an opinion formed under average conditions can be quite misleading. This applies both to the quality and quantity of the water, and it is important from both extremes because too much water (e.g., floods) must be foreseen. Where the lay of the land allows a river to be dammed up near the mill to form an artificial lake, many of the advantages of lake water result, and flooding risks can often be eliminated. As a rule land liable to flooding is easy to recognize, but floods are not strictly seasonal, and personal judgment by a stranger to the locality can be very misleading. Local knowledge on floods is usually quite reliable, but tends to be exaggerated; this is an error in the right direction.

The author has found that there are few countries nowadays where official statistical information on the flows of the more important rivers cannot be obtained. Moreover, there is usually a well-informed government department which can advise on these matters from an intimate knowledge of the watershed.

QUALITY OF THE WATER REQUIRED

In the early days of paper manufacture "only the best is good enough" was a safe criterion of quality. However, the diversity of pulp and paper manufacturing processes, and modern methods of water treatment have to a great degree altered this position, and a modern version of this maxim might read "suitable for the purpose is good enough."

The early standards were of course based on paper and not on pulp manufacture, and on the days of handmade paper on rag papers of the highest grades used for writing and printing, wrappings being virtually unknown. In the author's view the search for water need not be made more difficult by specifying for all the stages of manufacture a quality suitable for the most exacting stages. If there is only one source then of course this automatically follows, and so much the better, but this is by no means always the case.

Below are tabulated the TAPPI specifications (maximum quantities in parts per million) for waters suitable for the manufacture of four different types of paper, and a comparison of the figures (e.g., for turbidity) makes the above point clear. It should be noted that the specification for fine papers is not likely to be stringent enough for water for the manufacture of specialties such as photographic base papers, blueprint papers, cigarette papers, facial tissues, etc.

	Fine papers	*Kraft papers*		*Groundwood papers*
		Bleached	*Unbleached*	
Turbidity	10	40	100	50
Color (Pt. units)	5	25	100	30
Total hardness ($CaCO_3$)	100	100	200	200
Calcium hardness ($CaCO_3$)	50	...	...	...
Methyl orange alkalinity ($CaCO_3$)	75	75	150	150
Iron	0.1	0.2	1.0	0.3
Manganese	0.05	0.1	0.5	0.1
Free chlorine	2	...	...	...
Soluble silica	20	50	100	50
Total dissolved solids	200	300	500	500
Free carbon dioxide	10	10	10	10
Chlorides (Cl)	...	200	200	75

These figures apply only to *paper*. When dealing with the manufacture of pulp one must assume that the water for the last stages of washing the pulp (e.g., after bleaching) before it goes to the pulpers or beaters of the paper mill should itself conform to the appropriate standard as set out above. For the operations prior to this the chemical standards of purity of the water can, if necessary, be less, although freedom from suspended matter, whether coarse or moderately fine, is always important. For instance, for water used for filling the digesters a liberal tolerance of chemical purity is allowable, since the chemicals in the cooking liquors are added in such quantities that their effect overwhelmingly masks that of any saline matter in the water. Even dissolved organic matter (such as from surface water) is of minor importance, since it is eliminated by the digestion process much as are the non-cellulosic constituents of the plant used as raw material. The author knows of sulphite mills located on the coast which use seawater for this part of their process.

One cannot take such liberties with water to be used for the later stages of pulping, because after the removal of the black liquor the object is always to remove progressively impurities of all kinds. In this respect saline matter is of less importance than dissolved organic matter, although where a bleaching process is used (and nowadays it is usually multistage in nature), organic matter in the water is readily destroyed. The resulting increase in consumption of chemicals is usually trivial. Water for the intermediate stages of pulp manufacture (e.g., dilution for screening, etc.) usually comes from some form of recirculated back-water system.

Where a mill is making (say) bleached pulp for sale and not for its own use, obviously the quality of the water must at least attain the values given for fine papers in the above table. An intelligent use of the flexibility of these standards of water supply as applied to different pulps and papers and to different parts of the same process has been of great help in the location of sites. Thus it has often made possible the utiliza-

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tion of an otherwise desirable site whose supply of high grade water (e.g., from wells), is not sufficient for the whole process, although there is a supply of less pure water (e.g., from a river) to make up the deficit.

The actual standards set out in the above table call for a little comment. First, some of them should not be interpreted too rigorously. For instance, hardness and alkalinity, though no doubt objectionable in some respects, are not deciding factors in determining the suitability of water supplies, and many mills making fine papers of a high grade from water have higher hardness values than specified above. Indeed there is good reason to believe that hard water helps sizing by forming a resinate of calcium, thereby more than offsetting any small additional consumption of alum required to neutralize the alkalinity of the water. The chief trouble in process work arising from a hard water is scale formation, particularly on the drying cylinders. Where soluble silica is also present the author has experienced trouble with very hard and resistant scales which form in the potchers, especially in presence of hypochlorite bleach liquor.

The iron contents specified are also controversial, although in special cases (such as the manufacture of photographic and ferrobase papers) only very small amounts can be tolerated. In such cases the iron content of the pulp is of more concern to the paper mill than is that of the water used. Iron is supposed to combine with rosin to form dark colored resinates which lower the color of white papers, and relatively large quantities in the system undoubtedly do so. The author once tried the experiment of deliberately adding soluble iron salts to the beater, and was surprised to find what a large dose was required to produce a noticeable difference in either the iron content or the color of the paper. The success of this experiment made it possible to use a grade of alum containing more iron, and therefore cheaper. It therefore seems that the iron content of the paper is dependent only to a small extent on the soluble iron content of the water.

The table makes no reference to chlorides in connection with fine papers, although these will be included in the dissolved solids. The upper limits specified for the other three papers (which incidentally, are rather inconsistent as between kraft and groundwood papers) arise from the tendency for large amounts of chlorides to promote corrosion of certain metal parts in the manufacturing system. This is a point which must be watched if sea water is used at any stage, or if the fresh water comes from rivers or wells near the sea, where salt infiltration is liable to occur. In the case of fine papers however, chlorides can also be objectionable because of their effect on the paper itself. There is good reason to believe that especially under warm and damp conditions and at low pH values, acidity will develop from chlorides present. This in time attacks the cellulose and lowers its strength and durability. Striking instances of this were apparent in papers made in the early days of bleaching powder when the importance of bleach residues left in the pulp was not realized until it showed itself in a most disastrous way.

In some actual specifications which the author drew up for the papers having a maximum degree of permanence the chloride content of the paper was specified as not exceeding 0.05% and the pH value as not less than 6.0. Chloride contents of this order are more likely to arise from the pulp than from the water, but it is most desirable to insure, when choosing a site for a mill for such papers, that the chloride content of the water does not exceed 15 parts per 1,000,000 as Cl. To depend entirely on the dissolved solids figure may be very misleading.

The other figures in the table call for little comment. Residual chlorine will not arise in natural waters, but may if the supply is being shared with a township. It is specially undesirable if tints are being made. The figures for free carbon dioxide (which may cause corrosion) and for soluble silica (see above) are rather stringent. A low manganese content is desirable; not only can it produce discoloration, but its presence in paper for wrapping fatty foods can induce rancidity.

It is neither economic nor necessary to soften water required for process work (although it is essential of course to do so for steam production). However, a certain amount of process water treatment can be carried out inexpensively. Full details are outside the scope of this paper, but such treatment invariably starts with some form of coarse straining to remove floating debris, followed by finer filtration, usually through sand pressure filters, to remove coarse turbidity. Where fine turbidity is present or the water is colored (e.g., peaty moorland waters), chemical treatment must be applied. Simple automatic dosage with alum alone or mixed with ferrous sulphate is usually adequate. It must be followed by coagulation, sedimentation, and filtration of the clarified water through pressure filters. Chlorination to prevent slime formation can conveniently be applied at this stage, and the analyses of the resulting water should then conform to the appropriate specification given above, subject of course to the comments that have been made.

In this way a wide variety of sources of water can be made suitable for pulp or paper manufacture. However, having chosen the site with this in mind and having specified the water purification plant, care should be taken that it is adequate for all types of weather. The author has seen rivers in some parts of the world, where they have a large watershed, transformed by rains in a matter of hours from a placid clear and colorless stream to a muddy coffee-colored torrent, which would put a strain on any water purification plant. Where this is likely to happen an adequate reservoir of water must be provided to neutralize its effect. In one case water was pumped from a river during its calm periods up to a small artificial lake in an upland valley, from which the water was drawn and treated as described above for process work.

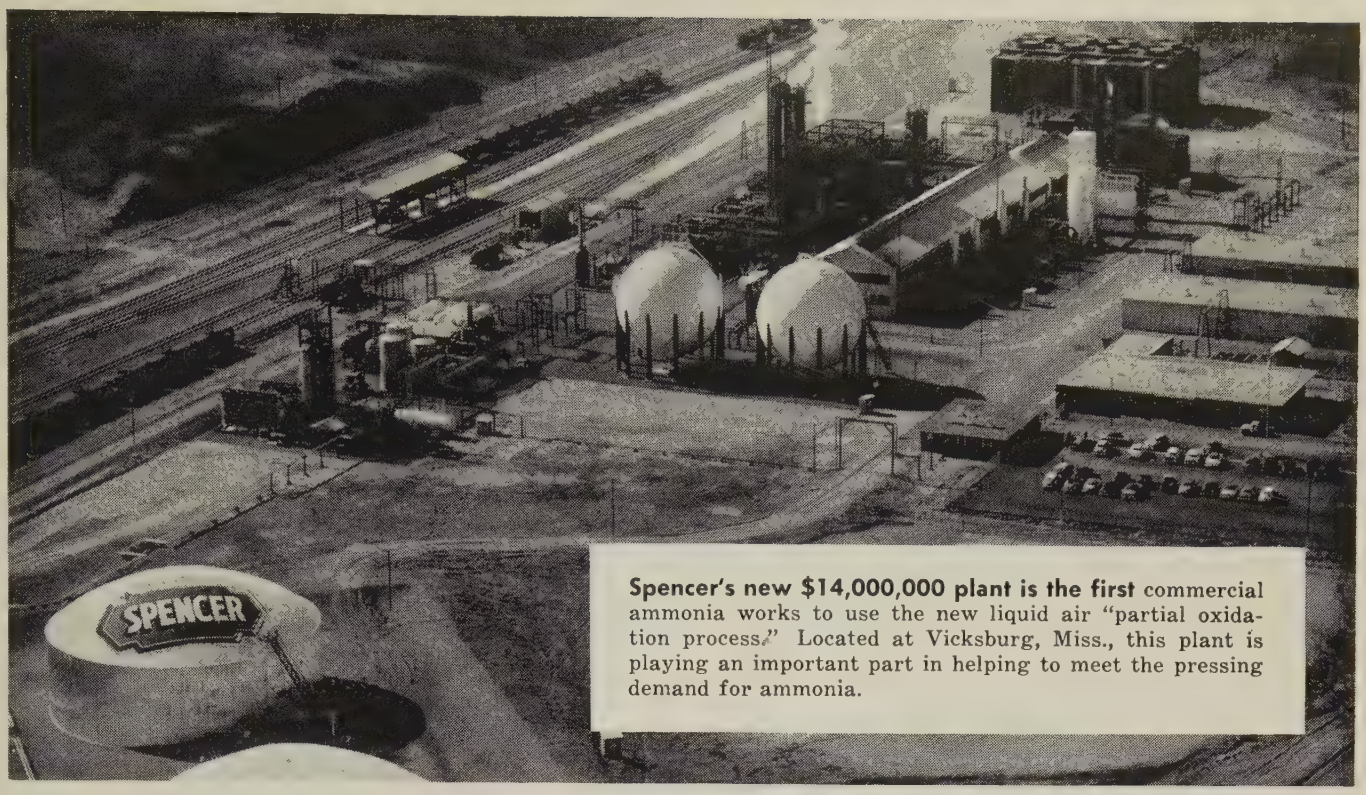
It should be noted that a water suitable for mill process work or for steam is, even after treatment, not necessarily a safe drinking water from a bacteriological point of view. In isolated areas therefore, where the same supply of water has to serve both the mill and domestic uses, a portion of the supply should be isolated and subjected to proper chemical and bacteriological examinations at frequent intervals. Failure to safeguard this point resulted once, in the author's experience, in a serious outbreak of disease.

EFFLUENT DISPOSAL

This is a very wide subject, and only the principal aspects of it affecting the choice of a mill site can be covered here.

The author has found throughout the world and even in so-called underdeveloped countries, that there is a rapid growth of river consciousness. Sometimes, notably in small countries with small rivers (such as Great Britain), this has already shown itself by highly restrictive legislation. This creates severe problems for existing mills, and makes it extremely difficult to extend them or to erect new mills; even tidal waters are not entirely exempt. These tendencies even exist in countries with large rivers which have as yet little industry. In the author's view therefore, it is most unwise to select a site on the assumption that the mill will be able to discharge its effluent into a local stream merely because no restrictive act has ever been taken before. It is always desirable to consult frankly with the responsible government or other official department indicating the likely volume and chemical composition of the effluent, and to obtain official consent to its discharge.

Where an effluent cannot be discharged into the sea there is seldom an alternative to the use of a river. However, there have been special cases, for instance, where it has been possible to make use of a disused mine or a large marsh with remarkable success. Rivers usually flow past towns, villages, or some form of habitation, and even if they contain no



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fish and have no scenic amenities they can be very objectionable if carrying a pulp mill effluent. They are also used in more remote areas for watering cattle (and even human beings), for washing purposes and for irrigation, so that in such places the effluent may even prove to be injurious. Even where the effluent is discharged into the sea one must proceed with caution and study the currents, especially on a tideless sea such as the Mediterranean. The author had one case where the currents prevailing around the proposed point of discharge would most effectively have carried the effluent, virtually undiluted, on to the local bathing beach some 8 miles away! The installation of a pipe line running about 500 meters out to sea in a selected direction overcame this difficulty. In another case where a large isolated lake was used as a source of process water, it was possible to arrange for this water to be taken from near the head of the lake and the effluent to be discharged into the middle of the lake, so that its effect was not apparent in the outgoing river.

Another device, which is possible in urban areas, is to segregate the relatively small volume of really bad effluent, partly treat it by sedimentation and coagulation, and then to discharge it into the local sewer where it mixes with the domestic sewage of the locality and is treated with the latter in the usual way. This of course can only be done by arrangement with the sewage treatment authorities who will certainly specify the amount and composition of effluent which they can accept for treatment. Moreover, the method will only apply to relatively small mills using an alkaline process, as sulphite liquor cannot normally be dealt with so simply. In the course of some experiments on these lines the author found that a mixture of diluted black liquor with domestic sewage (to provide nitrogen) could be purified on ordinary coke percolating filters, as commonly used in sewage works. This discovery has since been developed as a process for treating such effluents.

Where paper only is being made, in normal circumstances and assuming the efficiency and good management which goes with an up-to-date plant, there should be no real effluent problem. Suspended fibrous matter is normally the only impurity involved, and it is both easy and highly remunerative to recover this from the effluent. The problem is more acute with sulphite pulp mills than with soda or kraft mills, since the latter employ a soda recovery plant which has the dual purpose of chemical recovery and the reduction of effluent. There are, however, even in this instance the washings from the green stock after digestion and also the less objectionable white stock washings obtained during and after bleaching; though containing less dissolved organic solids these contribute suspended matter. The author's view is that prevention is better than cure, and that kraft processes should be so planned as to involve a maximum of liquor and washings going to recovery. A recent procedure involves an efficient countercurrent washing method which gives only washings and black liquor of such a concentration that they can be sent direct to recovery. This method therefore is of major importance and very promising; it not only solves the effluent problems, but also improves the efficiency of the recovery process by giving both higher heat and caustic soda recoveries (due to the higher concentrations of organic matter and spent alkali present).

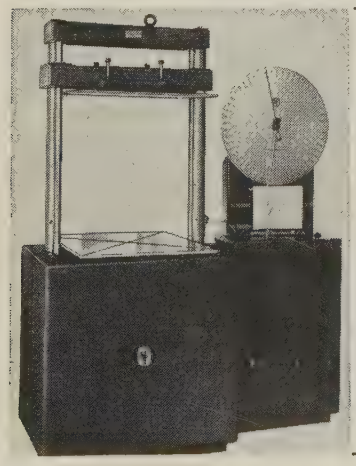
With the sulphite process no complete solution to the problem yet exists. Many methods for utilizing sulphite liquor, and two methods of recovering it exist, but none of them solves the problem completely and economically. Similarly with the monosulphite, Celdecor, and mechano-chemical processes the problem is as yet unsolved, although the last-named offers possibilities for the application of the countercurrent method.

This paper cannot deal in any detail with methods of treating effluent. However, provision on site should be made for large settlement tanks for removal of most of the suspended matter. If a chemical coagulant is used in a mechanical thickener the sludge is conveniently removed continuously, dewatered on a rotary vacuum filter, and re-used in boards or in low grade wrappings. Some years ago the author evolved such a method which, used in conjunction with dosage with bleaching residues containing chlorine and aeration (to reduce the biological oxygen demand), gave a satisfactory effluent from soda esparto pulp washings.

The standards to which effluents must conform if they are to be discharged into rivers vary considerably in different parts of the world. In Great Britain "pollution" is defined as that which changes the nature or composition of the river, so that theoretically the addition of hard water to soft water or warm water to cold water is pollution, and therefore an offense. In practice, however, the quality of the effluent is defined in terms mainly of suspended solids and B.O.D. Hitherto standards of not more than 3 and 2 parts per 100,000, respectively, have been used. There are certain tolerances for suspended solids if dilution by the river is high. While reasonable for sewage affluents, these standards are often both inappropriate and unfair to trade effluents, and the whole question is now under revision. It seems that in the future the standards chosen will be formulated so as to take more into consideration the nature and volume of the effluent and the flow of the river into which it is discharged.

Few other countries have numerical standards of purity, and the criterion of suitability usually adopted is simply whether the effluent is likely to be offensive or injurious. Effluent disposal can often provide serious difficulties in the selection of a site for a pulp mill, but given a resourceful approach on the one side and sympathetic consideration on the part of the authorities, the author's experience is that a solution is usually forthcoming.

Presented at the ECLA/FAO/TAA Latin American Pulp and Paper Meeting, Buenos Aires, Argentina, Oct. 18–Nov. 2, 1954.



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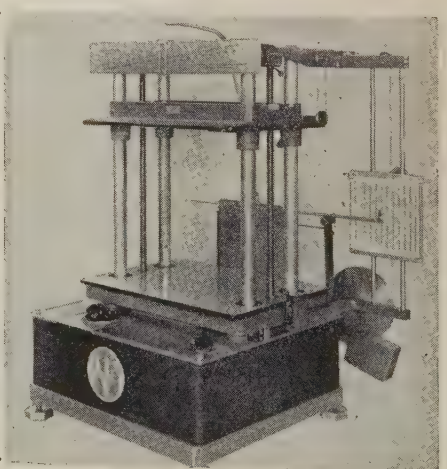

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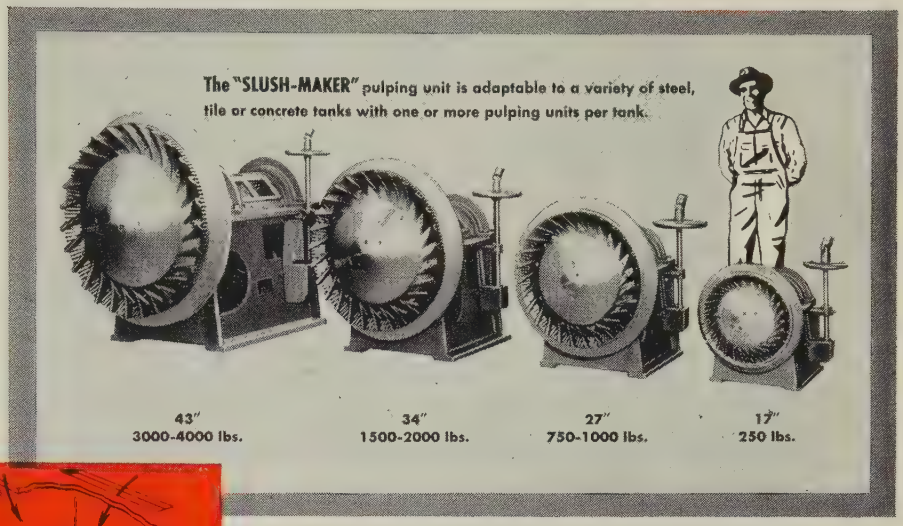

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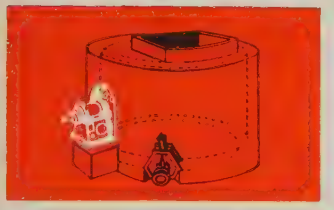

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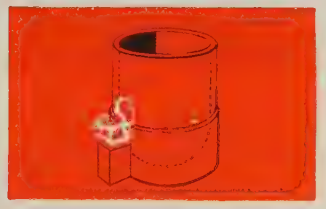

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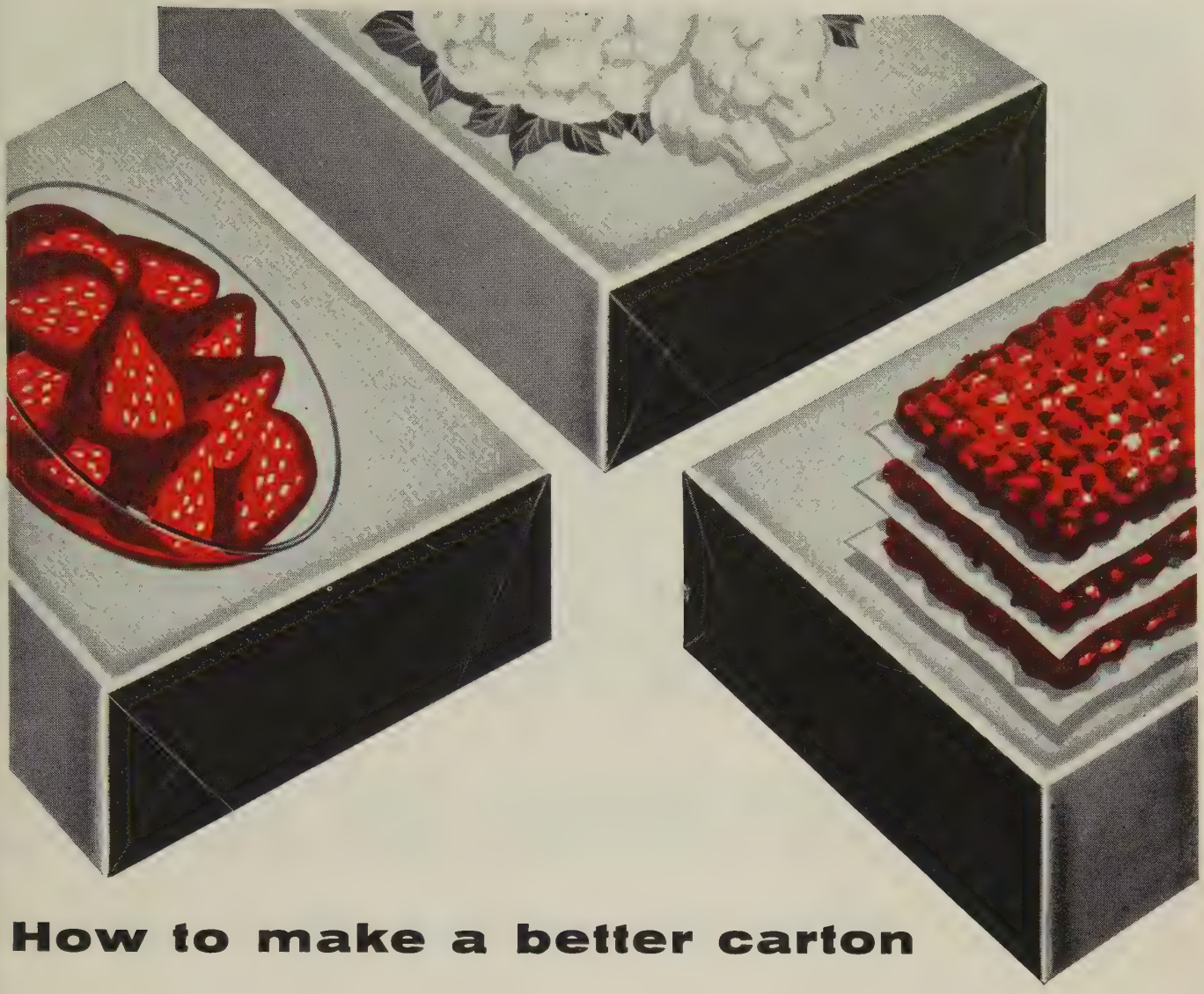

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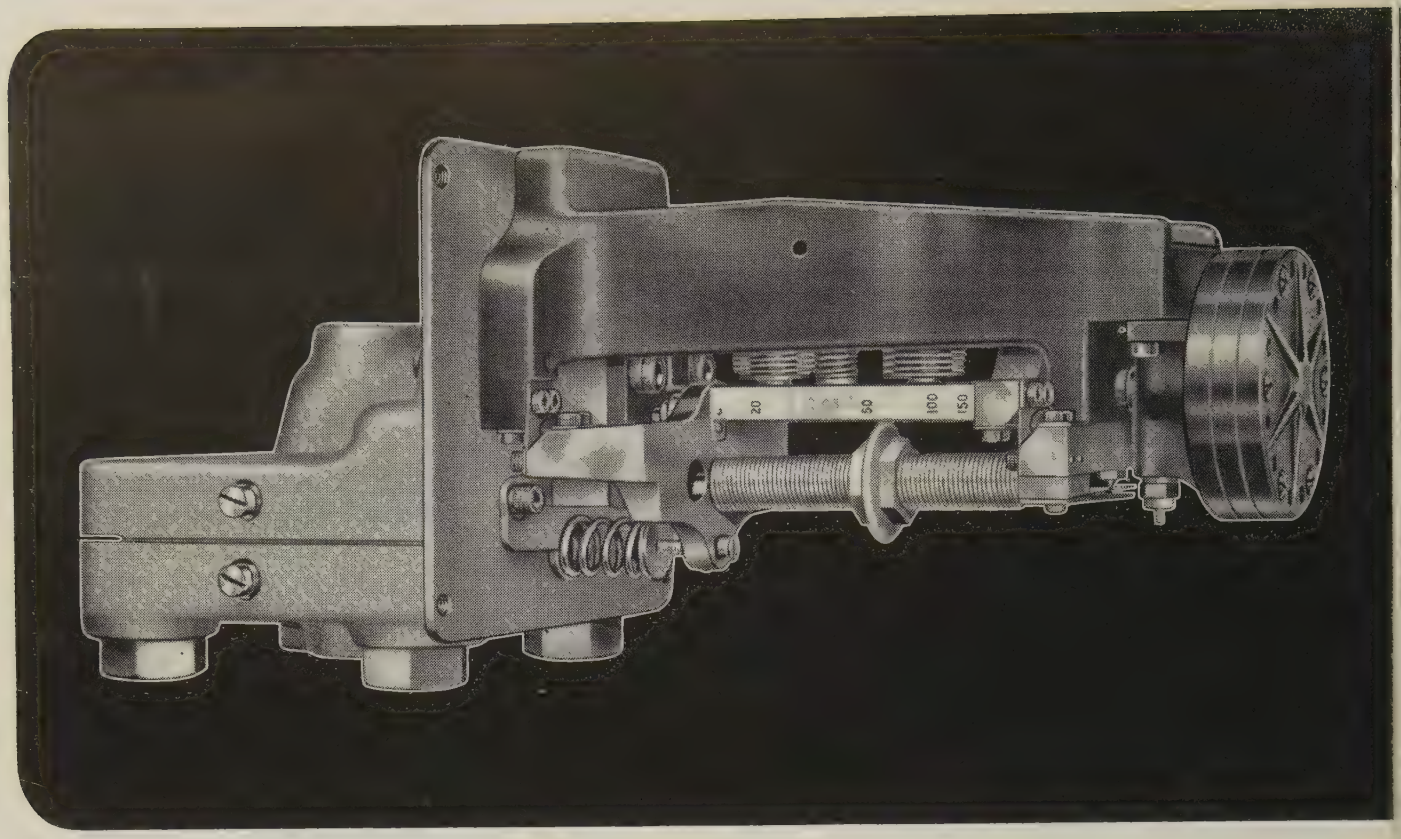

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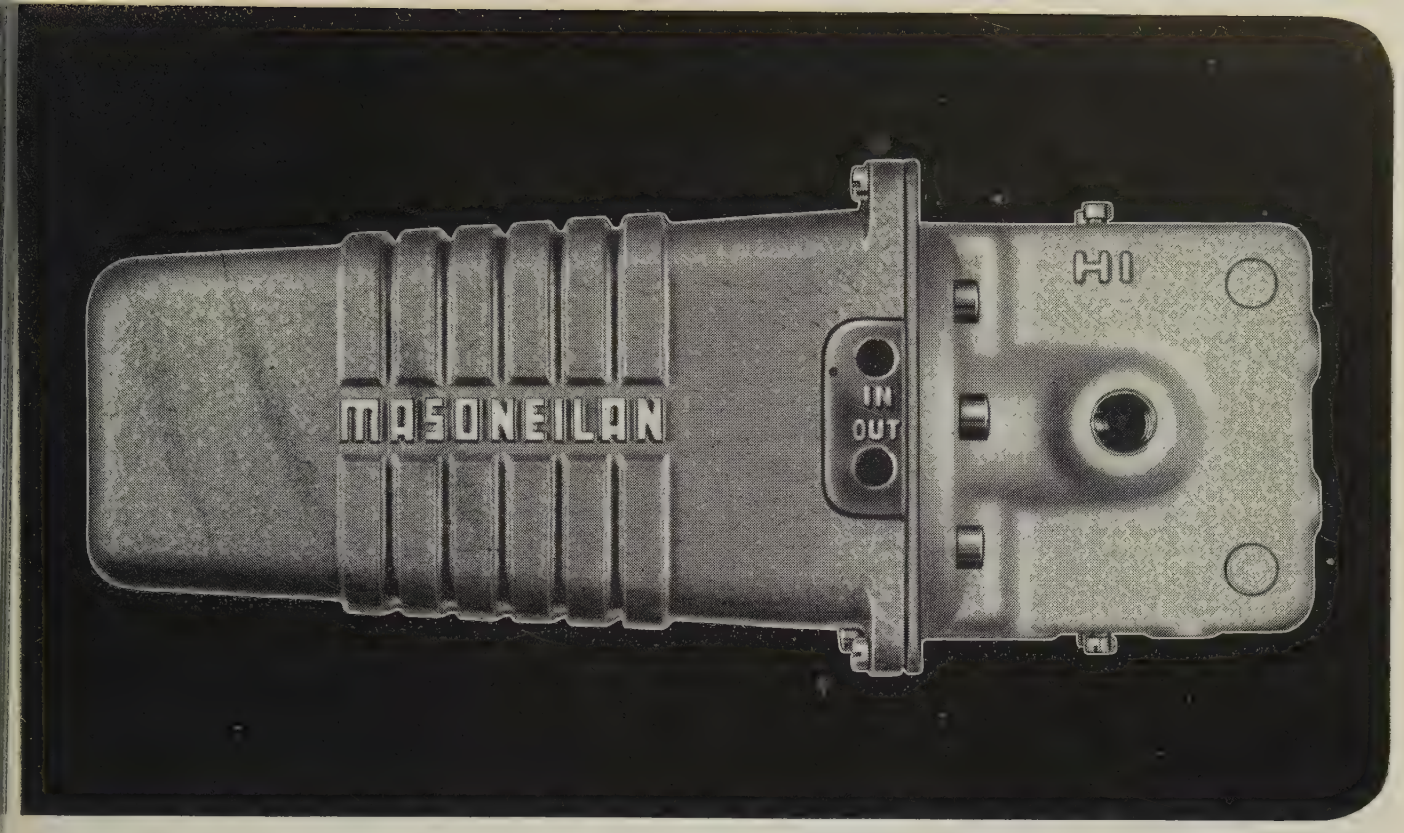

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● Drain connections at lowest point in diaphragm housing; vent connections at highest point in diaphragm housing — insures proper venting and complete drainage of condensate on both high and low sides.

● Materials selected for maximum strength and accuracy with highest corrosion resistance and minimum temperature error (1% per 100°F ambient temperature change).

These and other design features make Masoneilan Model 4800 Differential Pressure Transmitters outstanding among instruments of this type. Write for complete information.

SPECIFICATIONS

Range — Adjustable from 20″ to 200″ H_2O

Static Pressure Rating — 1500 psi

Ambient Temperature Rating — minus 30°F to plus 180°F

Weight — approximately 30 lb.

Pressure Connections — ½″ NPT internal

Air Supply — 20 psi

Output — 3-15 psi

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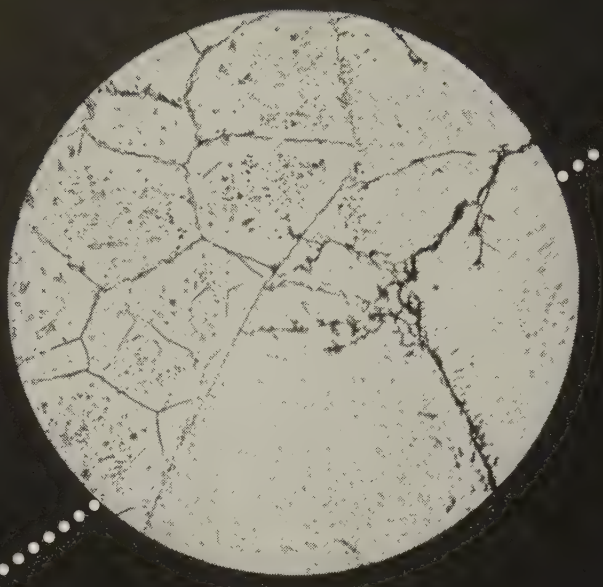
MASON-NEILAN REGULATOR CO.

1207 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis • Tulsa Philadelphia • Houston • Pittsburgh • Atlanta • Cleveland • Cincinnati • Detroit • San Francisco Boise • Louisville • Salt Lake City • El Paso • Albuquerque • Charlotte • Los Angeles Corpus Christi • Denver • Appleton • Birmingham • New Orleans • Dallas • Seattle Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

Here's a better solution to a tough Corrosion Problem



Carpenter 7Mo Stainless Tubing & Pipe

The corrosion-inviting cracks in the right-hand section of the photomicrograph above end abruptly as they near the center of the picture . . . and that quick ending may help you find a quick ending to stress corrosion cracking problems.

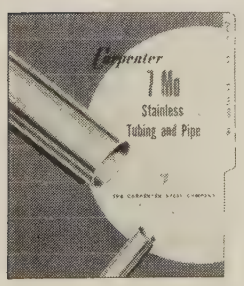
The picture is Carpenter 7Mo stainless pipe (left) welded to a Type 316 fitting. It is still unaffected by the stress corrosion cracking that has destroyed the usefulness of the fitting. The pipe outlasted three such fittings before the photomicrograph was made.

The stout resistance of Carpenter 7Mo to stress corrosion cracking, even in the presence of chlorides or other caustic and sulphite solutions, is coupled with excellent resistance to general corrosion and pitting. It has been used as a "problem solver" in food and chemical processing plants, pulp mills, petroleum refineries and other places. There may be a profitable place for it in your operation. We'll be glad to work with you, aid you in investigation of your problems and a possible 7Mo solution.

MEMBER

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"



Write for your copy of the Carpenter 7Mo Technical Bulletin containing comprehensive data.

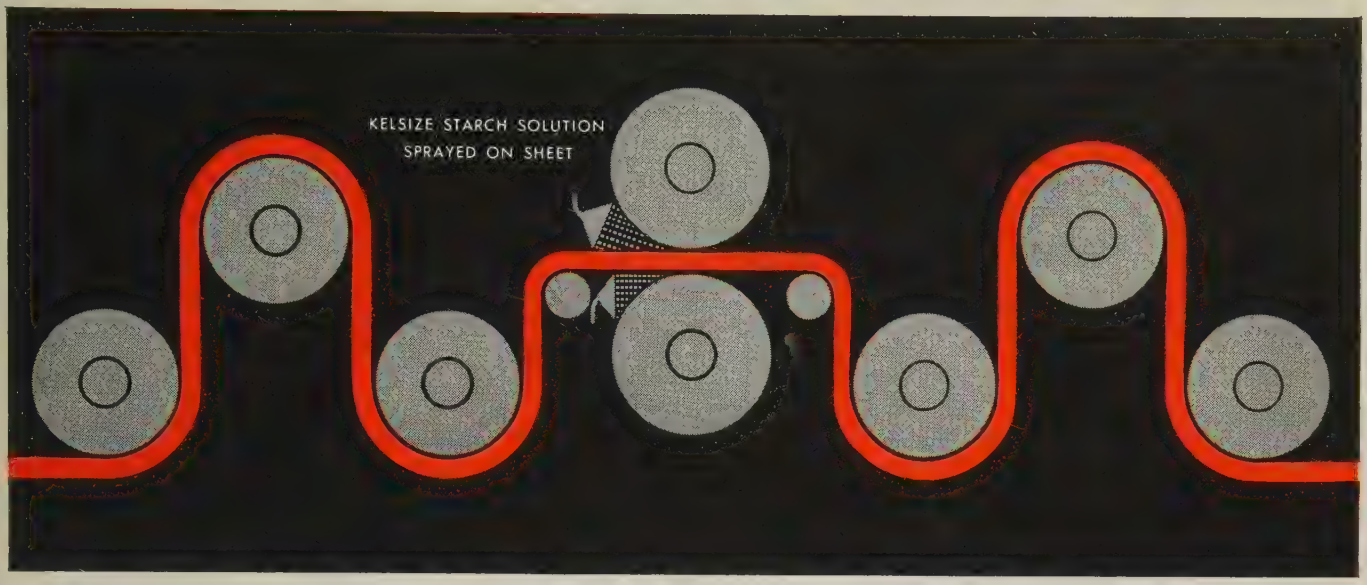
Carpenter

more than corrosion resistance

Stainless Tubing & Pipe

TEST-PROVE *increased* { *densometer* / *finish* / *printability* } *with*

KELSIZE *and* STARCH *combination*



If you use fourdrinier machines, test-prove for yourself these definite advantages of KELSIZE-Starch Solution in your size press application.

1. Increased densometer.
2. Improved control of wax penetration.
3. Improved printing surface.
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5. On unbleached Kraft gumming stock, application results in improved densometer, which in turn results in better gumming application and tear strength.

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Try KELSIZE-Starch . . . a versatile combination which will give you all these advantages in one operation.

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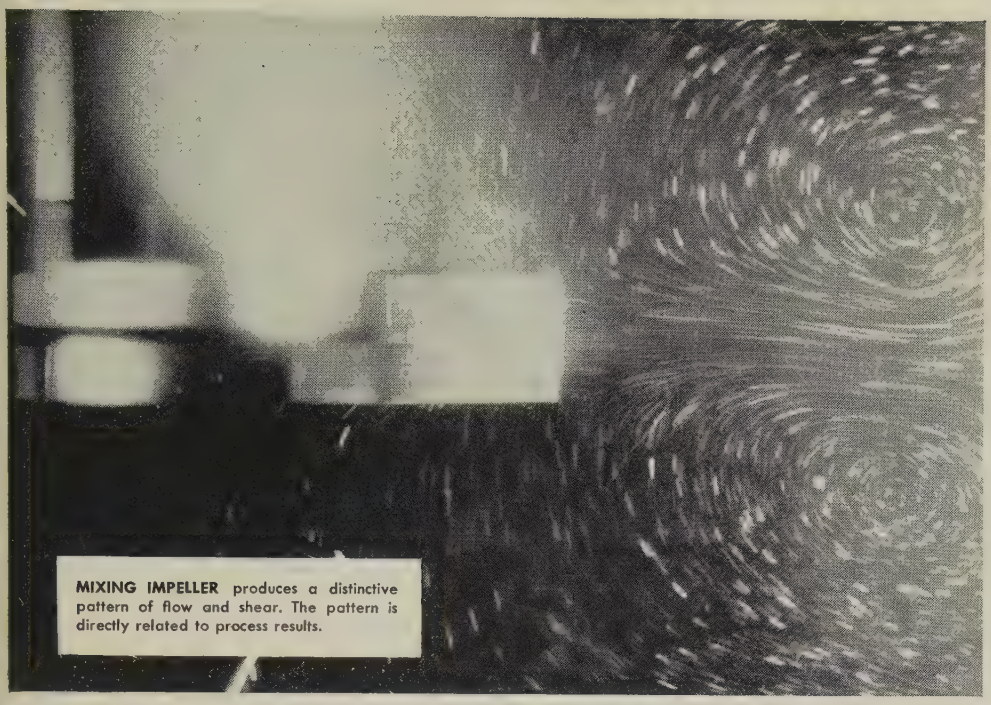

MIXING IMPELLER produces a distinctive pattern of flow and shear. The pattern is directly related to process results.

Why this flow pattern **works for you** *when you mix fluids*

You're looking at a "pattern for profit," set in motion by the whirling blades of a fluid mixing impeller.

Whenever and wherever you mix fluids in a tank, a pattern like this works for you—or against you.

When it works for you, you get uniform coatings, at low cost. You get a smooth-running starch system. You get stock of good consistency, right through to the headbox, with a minimum of control measures.

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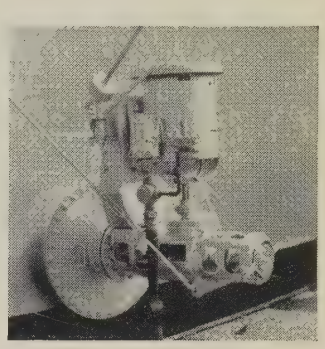
We've spent 25 years studying the process results produced by this impeller, and by modifications of it. Learning what this flow pattern can do—to make sure you get the *right* "pattern for profit" in your tanks and stock chests.

We've reached a point where we can guarantee fluid mixing results, unconditionally. In some cases, we can save you as much as 40% on initial mixer cost, by eliminating the need for excessive horsepower.

If you think "profit-pattern" mixing is worth looking into before you select any more fluid mixing equipment, get a headstart now by calling in your LIGHTNIN Mixer representative. (His name is in your copy of Thomas' Register.) Or write us today.

GET UNIFORM MIXING, rapidly, in any size tank, with LIGHTNIN Mixers like these. Hundreds of power-speed combinations. Sizes 1 to 500 HP



NO STUFFING BOX TO REPACK on LIGHTNIN Side Entering Mixers equipped with new rotary mechanical seal that runs for years, but is easy to replace if necessary. A maintenance cost-saver on rectangular chests and other large tanks. Sizes 1 to 25 HP.

MIX ANY FLUIDS rapidly, at low cost, with LIGHTNIN Portable Mixers. Make any open tank an efficient mixing vessel. No baffling is needed. Thirty models, sizes ⅛ to 3 HP.

Lightnin® Mixers

MIXCO fluid mixing specialists

Get these helpful facts on mixing: cost-cutting ideas on mixer selection; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Free—no obligation. Just check data you want, tear out and mail to us today with your name and company address.

- ☐ DH-50 and DH-51 Laboratory Mixers
- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller types)
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MIXING EQUIPMENT Co., Inc., 142-d Mt. Read Blvd., Rochester 11, N. Y.
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What's *new* about Huyck felts?

CHAPTER I: MOVING DAY

You know the emptiness you'd feel seeing an old friend leave your neighborhood. We felt that way, too, the day we moved our entire Kenwood blanket operation to Cavendish, Vt.

Trouble was, we had no alternative. Space was needed for increasing production capacity to meet the growing demands of papermakers for *new* Huyck felts—and for additional equipment now being used in the development of *new* techniques in felt making.

Also, we knew that many advantages would accrue to papermakers—and to us—by going all-out for specialization in manufacture ... devoting *all* of our facilities and know-how to making felts, and felts alone, at Rensselaer, N. Y.

. . .

This is but a part of the continuing story of what Huyck is doing to help you produce better paper at lower felt cost per ton.

Just released — Huyck Felt Bulletin (Vol. II, No. 7)—*Factors Influencing Water Removal in a Plain Press.*
Write for your copy today.

NEW! HUYCK FELTS

FIRST IN QUALITY... FIRST IN SERVICE

KENWOOD TEXTILE PRODUCTS

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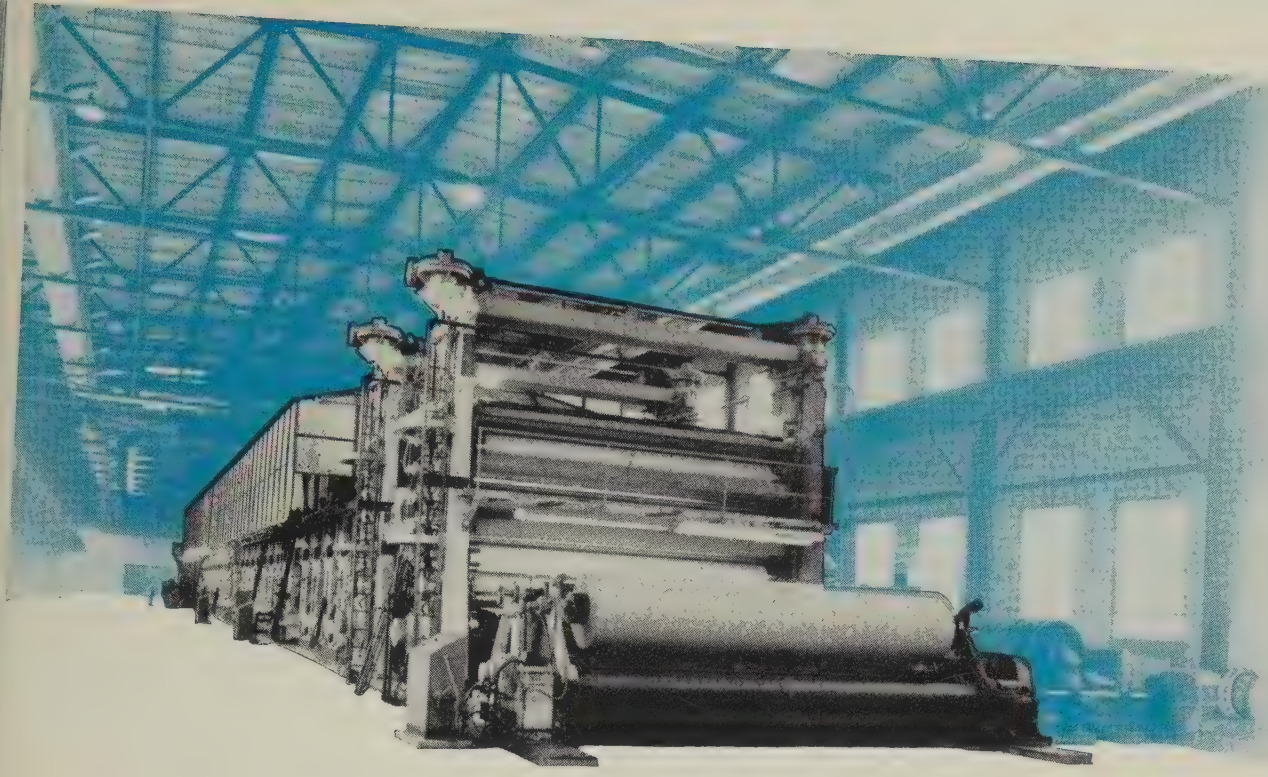
Established 1870



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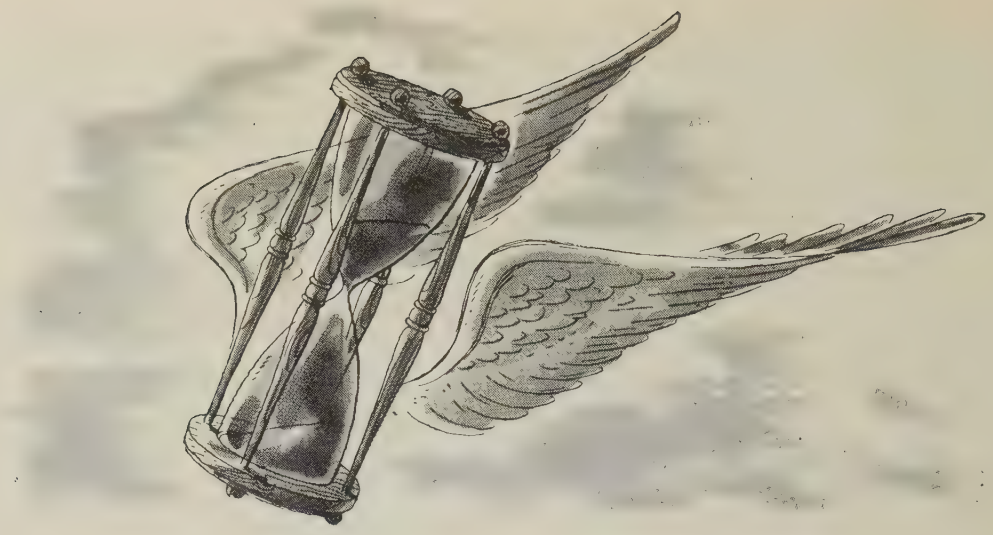

"Eheu, fugaces labuntur anni!"

Today, at Dicalite, we would translate that, very broadly indeed, "Good Heavens! Twenty-five years gone by so soon!" For, as we look back to 1930 and our beginnings, we feel a double sense of wonder . . . first, that a quarter-century has sped so fast, and then, that we (and diatomite) have come so far in so short a time.

As you know, Dicalite is both our Division name and the family name of a whole host of materials processed from diatomite. This unique material, once regarded as almost an oddity, used occasionally as 'chalk-rock' building stone or in fire-lighters, today serves important uses in more than 200 industries.

This great expansion is due, in no small part, to the warm cooperation of the industries which we serve. Their laboratories have worked with ours, their product engineers and ours have together pioneered new developments, new uses, for this versatile earth.

Hence, we would like to make this, our 25th milestone, an expression of thanks to the many industries throughout the world whose ready acceptance and continued use of Dicalite have made possible our growth. Their support has enabled us to advance from 1930's one deposit, one plant, to our present four deposits and four processing plants. Our obligation is cheerfully assumed and Dicalite will contribute even more greatly to industry's progress during our next quarter-century.

1930 • 1955
25
YEARS

Dependable GLC GREAT LAKES Dicalite®
DIATOMACEOUS MATERIALS

P.S. *The cryptic headline is from the Roman poet Horace (Odes II, xiv. 1). Its literal translation is "Alas, the fleeting years glide by," but we cannot echo the poet's expression of regret.*

DICALITE DIVISION, GREAT LAKES CARBON CORPORATION, 612 SOUTH FLOWER ST., LOS ANGELES 17, CALIFORNIA

For wet strength in a hurry—UFORMITE 700

UFORMITE 700 gives your paper high wet strength fast. In almost any kind of furnish—bleached or unbleached kraft, sulfite, or groundwood—you get high strength right off the machine.

UFORMITE 700 has other important advantages: *Highly efficient*—provides effective results over a wide range of resin-to-pulp ratios. • *Easily mixed*—no acid pretreatment, no special equipment needed. • *Simply controlled pH*—acid, alum, or blends of both can be used. • *Conveniently added*—at any desired point from beater to headbox. • *Long storage life*—the stability of UFORMITE 700 helps eliminate inventory problems.

Other Rohm & Haas chemicals for the paper industry include hydrosulfites for bleaching wood pulp; resin emulsions for paper coating and saturation; surface-active agents, pitch dispersants, deodorants, and bactericides.

CHEMICALS FOR INDUSTRY

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THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

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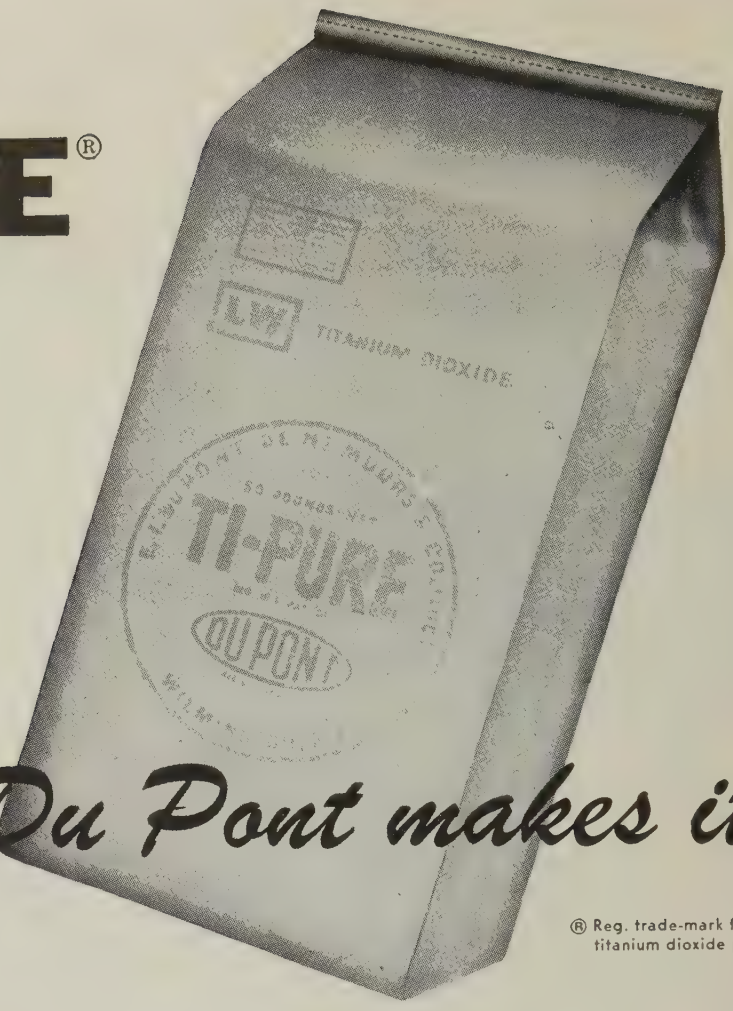
It takes TI-PURE®

TITANIUM DIOXIDE

to make paper opaque and bright



...and Du Pont makes it!

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YOU GET a titanium dioxide pigment which is specifically adaptable to paper manufacture. It disperses easily in water, has fine beater retention, low-water and adhesive demand—all of the important features needed for easy and sure use in paper furnishes and paper coatings. It's the best TiO_2 for paper we have ever made!

If you have any questions about the use of titanium dioxide in bread wraps, waxed board, glassine, bond or book—in fact for any paper application, just call us. Our Technical Service or Paper Laboratory may already have the answer; if not they'll be glad to work with you to find it. Just contact our nearest district office or write to: E. I. du Pont de Nemours & Co. (Inc.), Pigments Department, Wilmington 98, Delaware.

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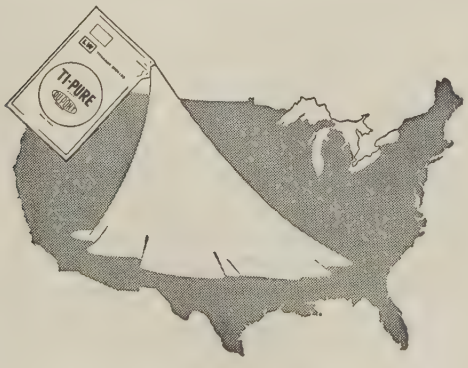

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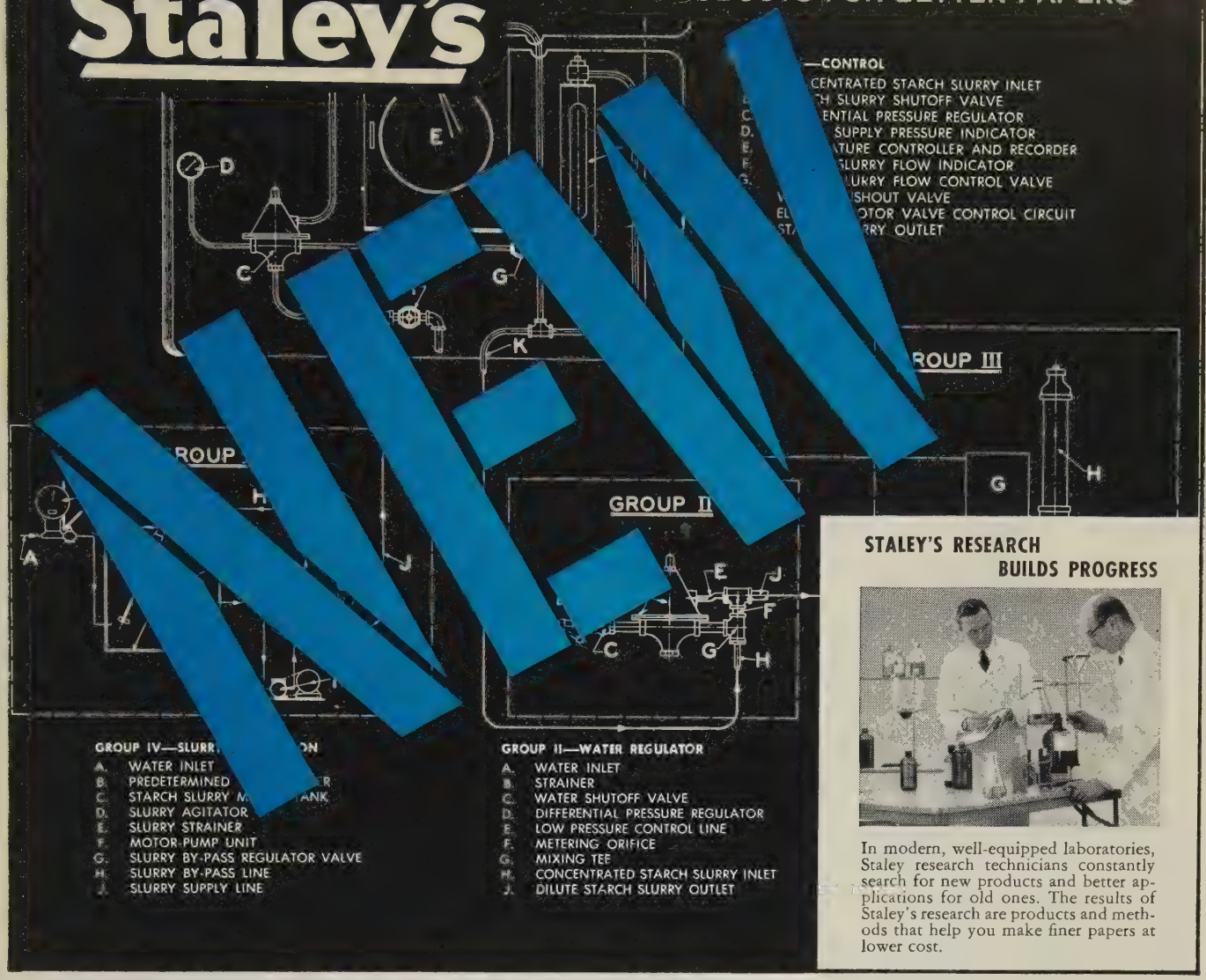

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New Staley Jet System revolutionizes starch preparation and application . . . cuts costs

NOW! After years of development and successful field testing, another major technological advance from Staley's . . . The Staley Jet System. This revolutionary apparatus provides for the first time *positive control over the full range of cooked starch properties and characteristics*, along with *continuous automatic addition* at the wet end.

The Staley Jet System adjusts to suit your purpose over the entire range of properties to the exact proper mixture. Set it . . . forget it! Starch is cooked and added at the wet end, *continuously* and *uniformly*. You save mixing time, reduce starch consumption, and improve functional quality of starch suspensions. See about the increased efficiency and lower costs the new Staley Jet System will bring to your plant now! Your Staley technical paper representative will furnish complete information at your request, or write for descriptive brochure.

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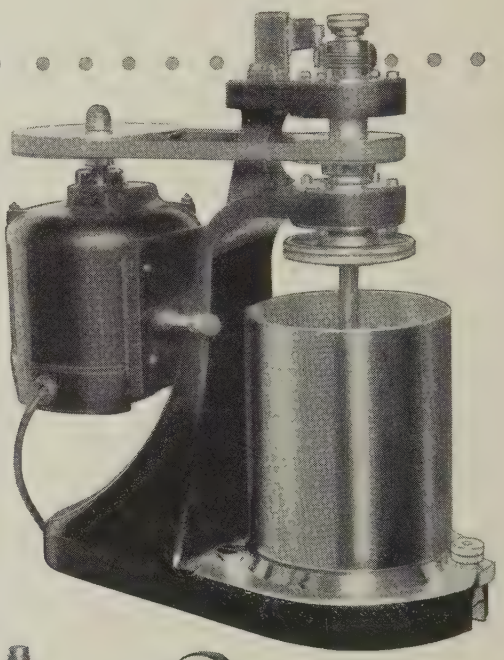
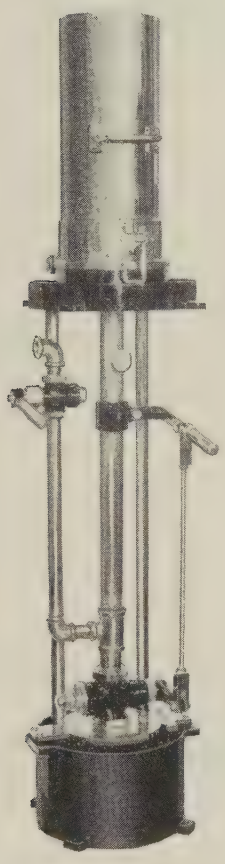
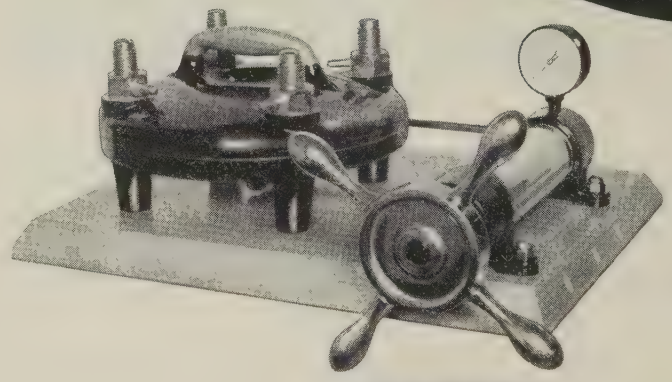


TAPPI Disintegrator



TAPPI Sheet Making Machine



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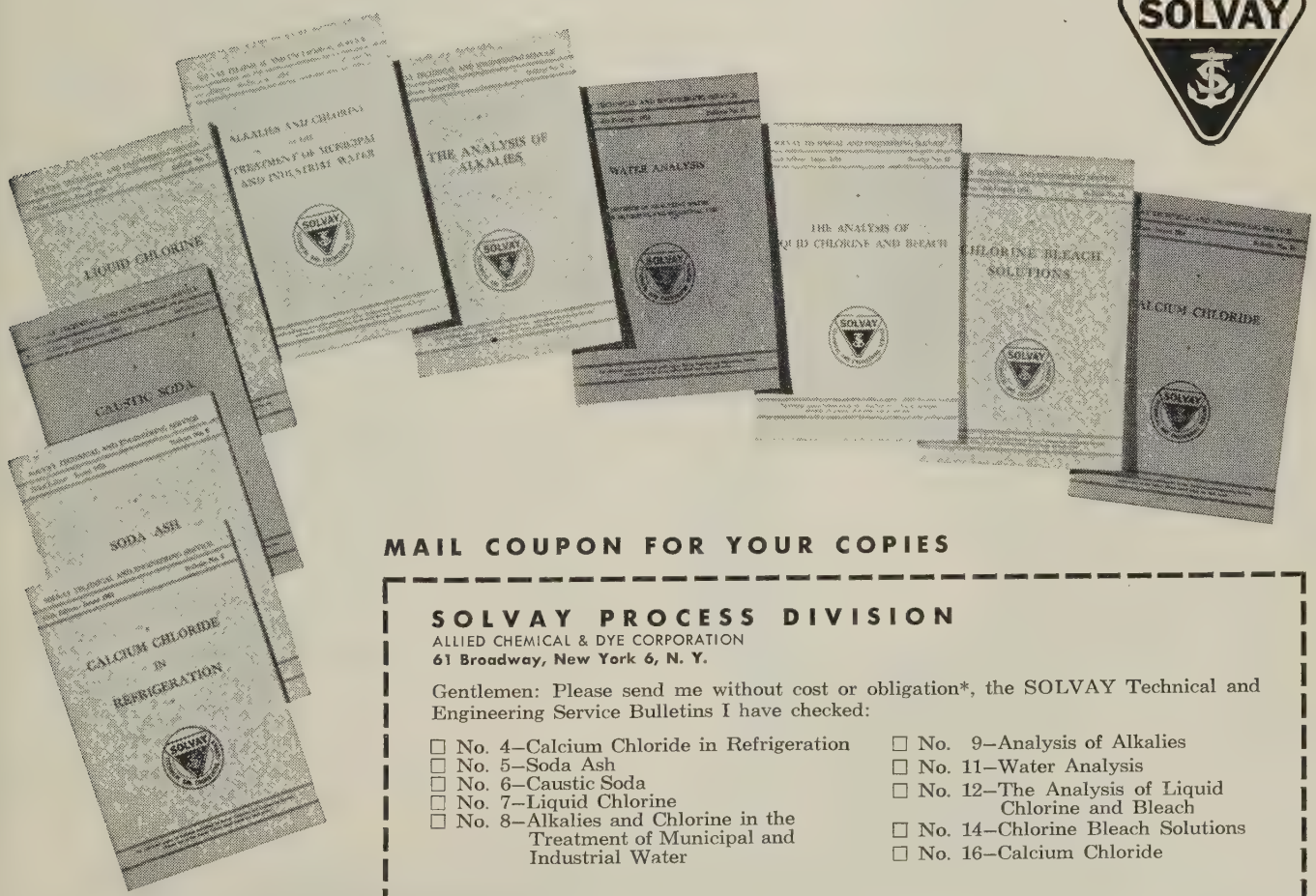

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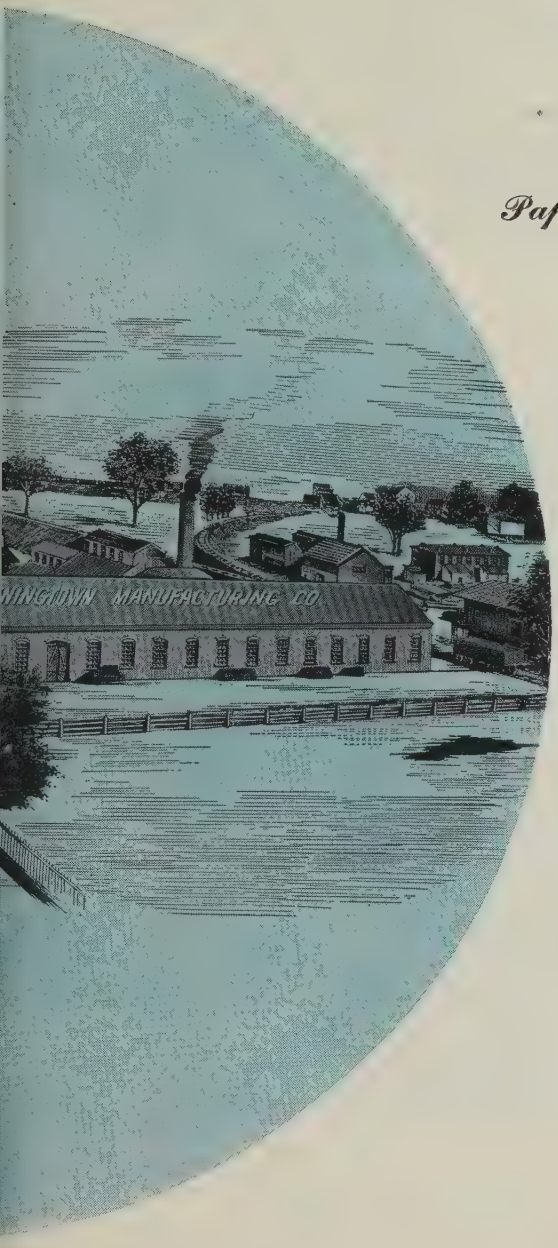

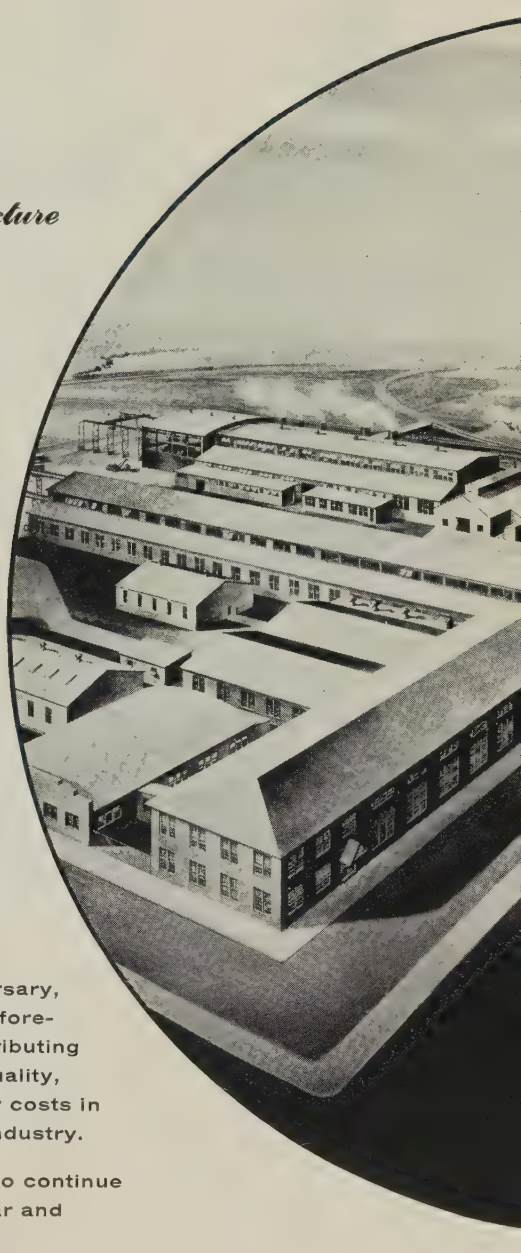

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Downingtown is dedicated to continue these contributions this year and in many years to come.

Downingtown Manufacturing Co.
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DOWNINGTOWN

DESIGNERS AND BUILDERS OF PAPER, BOARD AND FELT MACHINES

75 *th year*

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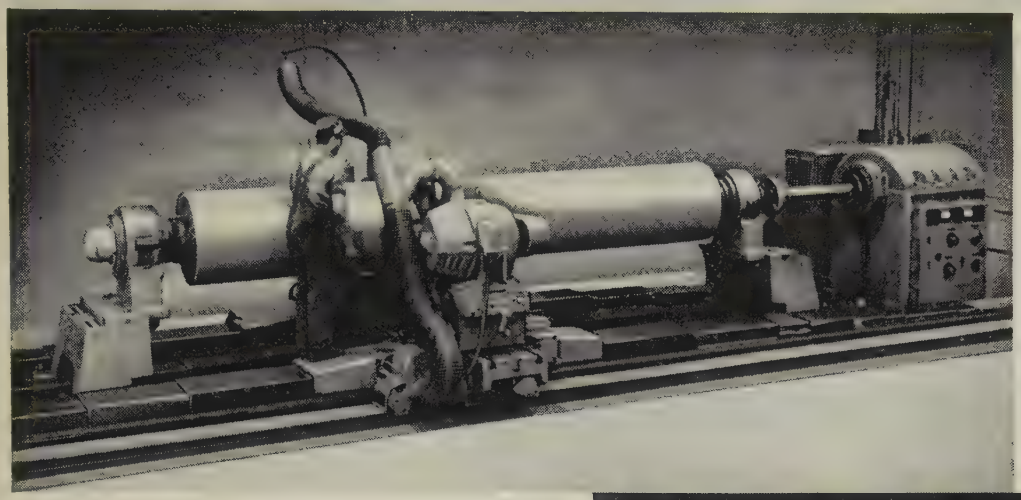
LOBDELL ROLL GRINDERS helping to increase production



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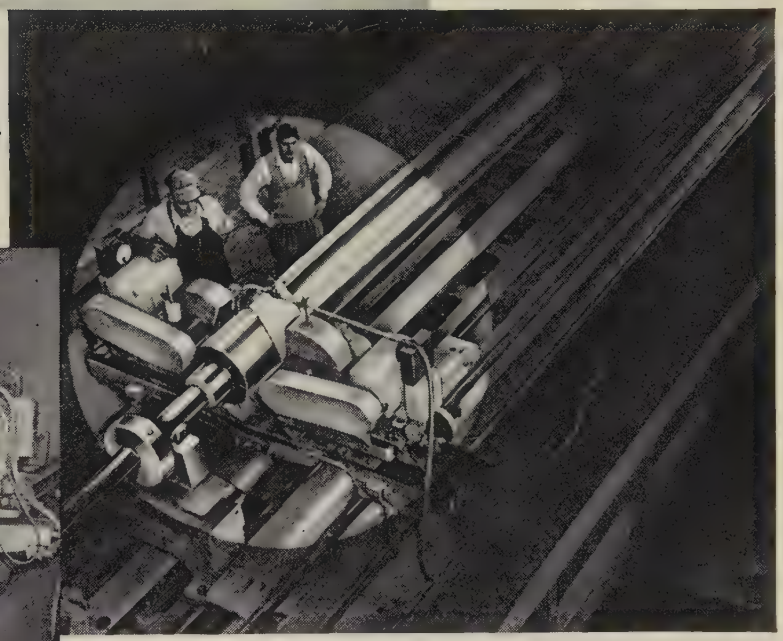

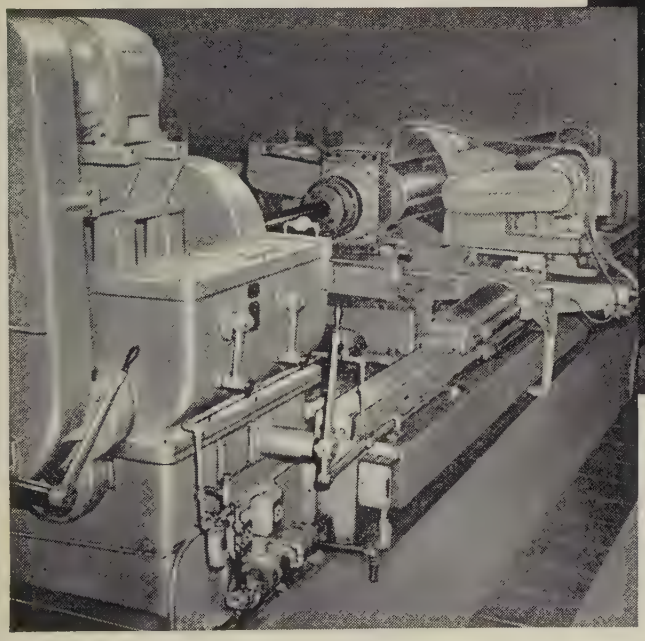

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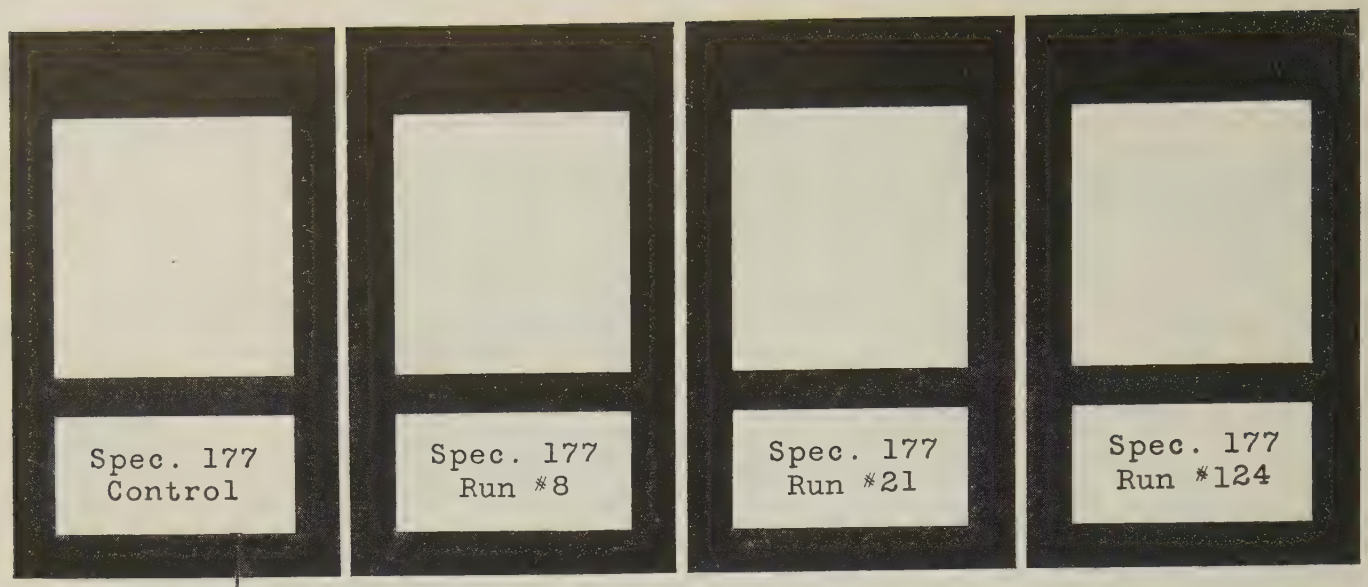

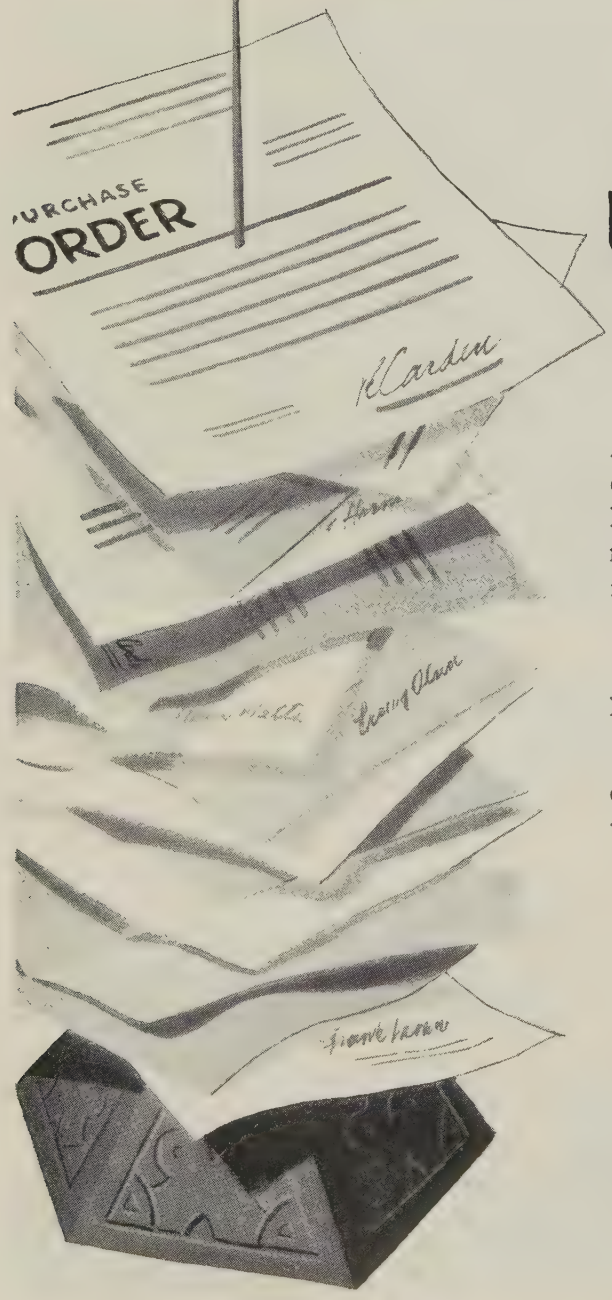

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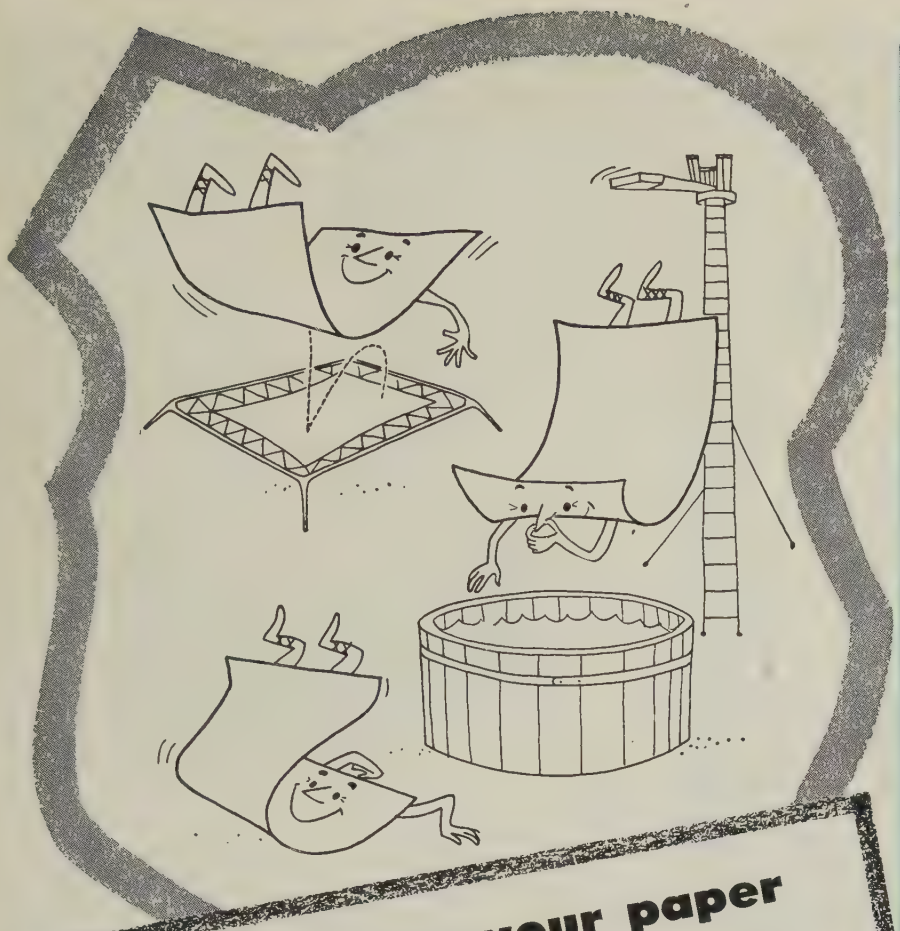

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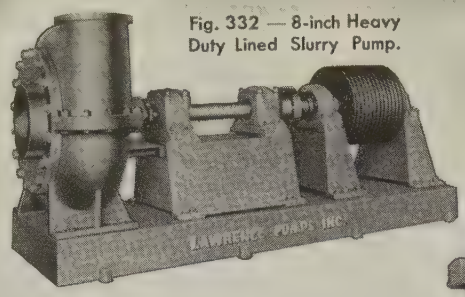


Fig. 332 — 8-inch Heavy Duty Lined Slurry Pump.

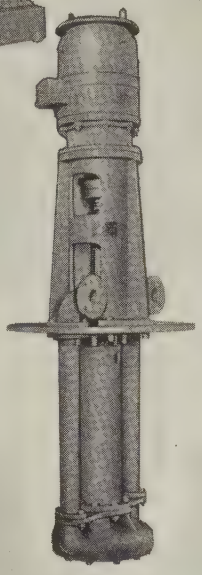


Fig. 244 — 4-inch Vertical Submerged Pump With No Bearings Below the Cover Plate.

Fig. 285 — 5-inch Vertical Top Suction Stock Pump.

Fig. 333 — 24-inch Horizontal Circulating Propeller Pump of Nickel Alloy Construction.

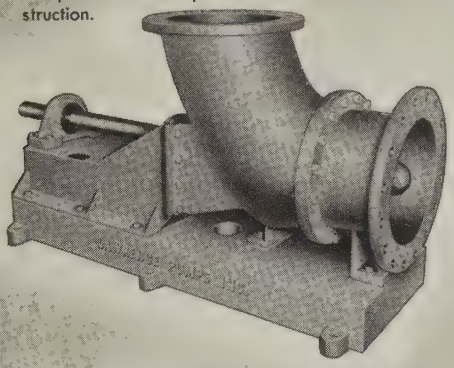
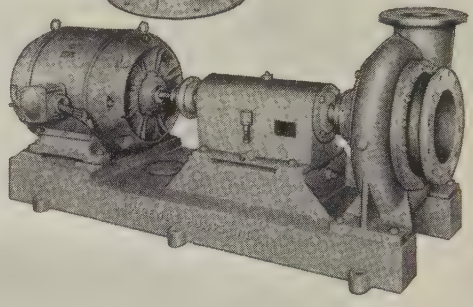


Fig. 337 — Lawrence 10-inch Heavy Duty Stainless Steel Chemical Pump.



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The Flow Properties of Paper Pulp Stock*

II. The Relationship of Shear Value to Pipe Friction for Soda Kraft and Groundwood Slurries

RICHARD E. DURST and LYLE C. JENNESS

A correlation, reported previously, relates the laboratory measured shear value of bleached sulphite pulp to the pipe friction of pulp slurries flowing through a piping system comprised of nominal 6-in. spiral welded steel pipe. The correlation was obtained by defining a dimensionless suspension flow number, N_{SF}, equal to $Dv\rho/S$, calculated from consistent units of pipe diameter, stock velocity, and stock density in slugs per cubic foot and the shear value, S, measured in the viscosimeter also previously described. A friction factor, f, calculated from measured head loss data became a function of the N_{SF} so that a log-log plot of f vs. N_{SF} resulted. The deviation of measured values from the straight line for the sulphite pulp was less than ±7%. More recent data show the correlation holds also for the three pulps; bleached soda, unbleached kraft, and unbleached groundwood. The correlation seems to hold equally satisfactorily for the sulphite, soda, and kraft pulps and with only slightly greater deviations for the groundwood pulp. The soda and kraft pulps were pumped at consistencies between 2 and 5%, and velocities from 1 to 10 f.p.s. The groundwood was investigated only in 2 and 3% consistencies.

THE relationship of shear value to pipe friction for bleached sulphite pulp slurries has been previously reported in a paper published by the authors in *Tappi* (*1*). The experimental program sponsored by TAPPI under the supervision of the Hydraulics Committee has been continued during the past year at the University of Maine using slurries of a bleached soda pulp, an unbleached kraft pulp, and an unbleached groundwood pulp. This paper reports the results of the investigation of these pulps.

The correlation of laboratory determined data of a pulp property with pipe friction data for the bleached sulphite pulp previously referred to is, to the authors' knowledge, the first successful attempt to provide a method for predicting fibrous suspension flow behavior in pipes from a property of the suspension measurable in apparatus other than simulated pipe systems.

The hydraulic data published by various workers (*2–10*) presented pipe friction data for stocks of definite properties which were used to obtain the friction data. The pulp characteristics generally were not defined, other than the type of pulp, i.e., soda, sulphite, kraft, etc. The pulp freeness and some data on fiber length were in some cases determined and reported with the friction data (*2*). It is generally recognized that there are wide variations in the various sets of friction data. The deviation between sets is no doubt due to a variety of causes, as for example, differences in the physical arrangement of the testing equipment, variation in pulps from different localities and their previous histories.

The logical development that should follow the amassing of a large amount of experimental data would be to reduce the data by mathematical analysis so a useful correlation could be obtained. Attempts have been made to obtain such a correlation from the existing data (*11, 12, 13*), and at least one of these (*13*) has been found useful in the study and prediction of pulp flow in piping systems.

The correlations which have been derived from existing published data necessarily reflect the variations in those data. The basic pulping processes change as research and mill practice develop new and improved techniques. The treatment of pulps subsequent to the pulping operations, as refining and bleaching, likewise are subject to improved operations. The physical properties of the pulps resulting from the changes in processing may be very different from those on which the pressure drop data were taken 10, 20, or more years ago. Thus, the old friction loss curves may become obsolete along with the old pulp mill operating conditions. The curves are difficult to prepare and again could be made obsolete by further changes in the mill conditions before they were published. In order to avoid the repetition of the work involved in the preparation of such curves for pulp stocks it is desirable to have more fundamental knowledge of the rheological properties of pulp stock suspensions.

THEORY OF PULP FLOW

It has been stated that an approach has been made to the rheology of pulp flow using a laboratory device to measure a property of pulp suspensions. There resulted from this work an empirical relationship between the friction loss of bleached sulphite pulp and

Nomenclature

Symbol	*Units*	*Definition*
ϕ'	Undefined	Coefficient of stock–stock friction
ϕ	Undefined	Coefficient of stock–solid surface friction
f	Dimensionless	Friction factor
ΔH_f	Feet H_2O per 100 ft.	Head loss due to friction
D	Feet	Pipe diameter
g_c	(Feet per second)^2	Constant 32.2 ft. per (sec.)^2 of gravitational acceleration
u	Feet per second	Mass average flow velocity
L	Feet	Length of pipe
ρ	Slugs per cubic foot	Stock density
s	(Pounds force) (seconds) per square foot	Stock shear value
N_{sf}	Dimensionless	Suspension flow number
ϕ	Undefined	In equation (3), function

RICHARD E. DURST, Associate Professor, and LYLE C. JENNESS, Professor and Head, Dept. of Chemical Engineering, University of Maine, Orono, Me.

* This study is a project of the Hydraulics Committee and has been supported by TAPPI Research Grant No. 64.

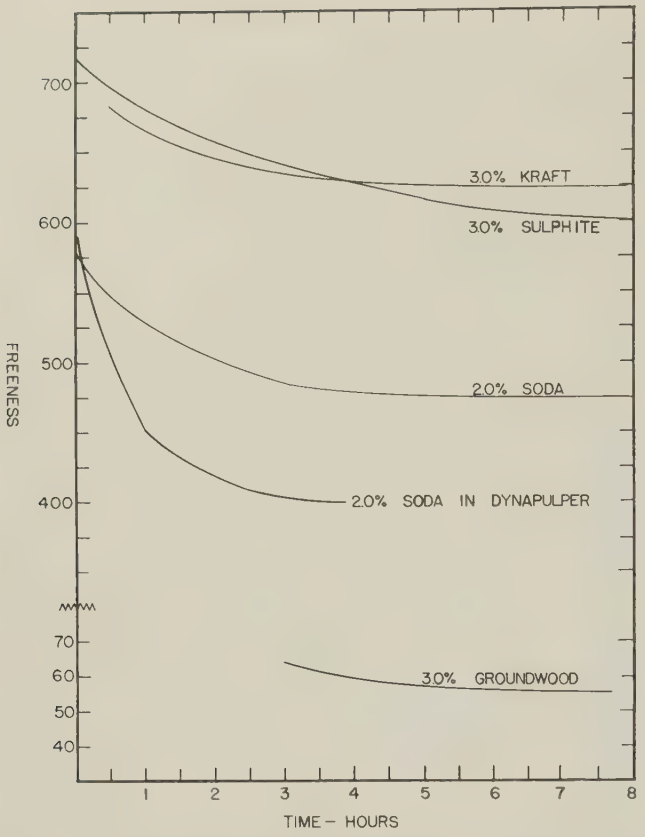

Fig. 1. Freeness versus pumping time for all pulps studied

that property of the suspension which has been designated "shear value." The relationship was empirical due to the necessity of using the rotor peripheral speed, rather than the velocity of the stock suspension being studied in the shear meter, to calculate the shear stress–shear rate relation.

Previously published work (*14, 15*) defined two friction coefficients for stock suspensions; stock–stock friction, ϕ', and stock–solid surface friction, ϕ. The former was considered to be nearly independent of velocity while the stock–solid surface friction was constant for certain low velocities, and smaller than ϕ', increasing rapidly over an intermediate range, during which time it became equal to the stock–stock friction, and eventually exceeded it but leveled off at higher velocities. From these observations plug flow and equilibrium flow were defined. Stock velocity and consistency were considered as factors which determined whether stock–stock friction or stock–solid surface friction controlled. The observations made during this investigation confirm the work of Baldwin and Van den Akker (*2*) that the total friction of a moving pulp stock in pipes is made up of two components, stock–stock friction, ϕ', and stock–solid surface friction, ϕ. However, it appears from observations that ϕ' is not independent of velocity. Increasing consistency is accompanied by increasing stock–stock friction for any given fiber. Furthermore, ϕ appears to decrease with increasing velocity to a minimum, after which it increases with increase of velocity. Fiber length and freeness are factors which affect both stock–stock and stock–solid surface friction coefficients.

Using the concepts of the two coefficients of friction described the flow of pulp stock in pipes may be pictured thus: at low velocities ϕ, being large compared to ϕ', stock cleavage results, while the stock at the solid surface remains at rest. This behavior has been observed both in the shear meter and has been indicated by measurements in the pipe test section. With increasing velocity, increasing cleavage results causing an increase of head loss due to friction. At the critical velocity ϕ' becomes equal to ϕ and slippage at the solid surface begins, (first maximum in the head loss curve for stock flow in the pipe). Further increases in velocity are accompanied by slight dewatering of the stock next to the solid surface and ϕ decreases (region of negative slope in the head loss curve). As the velocity reaches a second critical value dewatering reaches a maximum and the minimum in the head loss curve is attained. If plug flow ever occurs in stock flow it must be in the region of the minimum of the head loss curve where ϕ' exceeds ϕ in value. Finally, as the velocity is further increased turbulence in the mass of moving stock causes the water film to be adsorbed with gradual increases in value of ϕ. Turbulence also increases ϕ' and the second increasing rate of head loss with increase of stock velocity results.

It now appears that fiber length and freeness are the principal factors in determining both ϕ and ϕ'. The combined effect of the friction coefficients in turn determine the shape and magnitude of the head loss curve when it is used to express pipe friction for a given stock. The theory that has been advanced has some considerable validity from the data taken and observations made during the past 2 years. More refined techniques being developed, and other fundamental studies yet to be undertaken, should yield

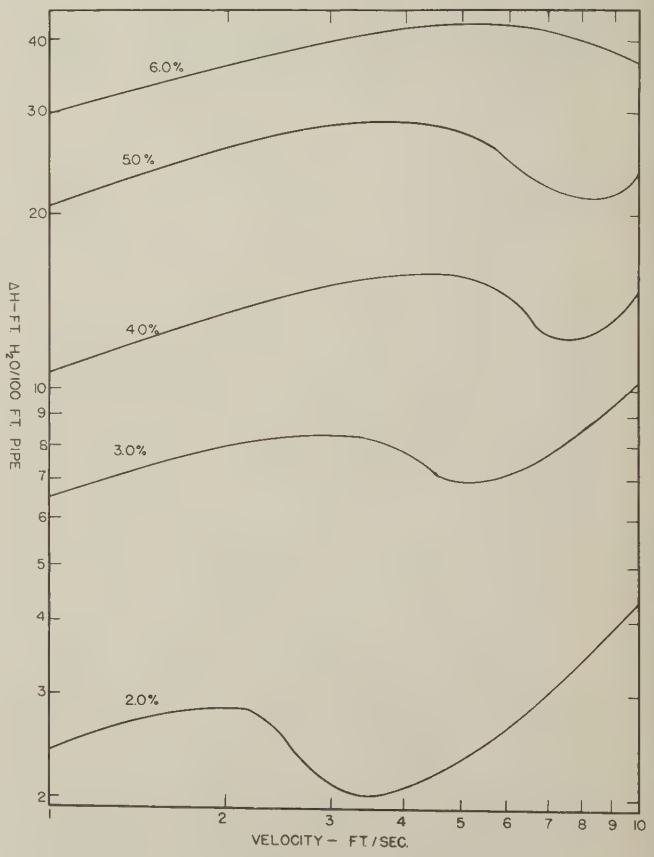

Fig. 2. Pressure drop–velocity relationships for bleached sulphite stock through 6.34-in. spiral-welded steel pipe

results which will more fully establish the theory of fibrous suspension flow.

EXPERIMENTAL PROGRAM

The correlation between shear meter data and pipe friction data obtained for bleached sulphite stock would be more useful if it were found to hold for similar data taken on other pulps. The stocks selected for the continued study were an unbleached Canadian kraft and a bleached hardwood soda pulp. It was also possible to obtain some data on an unbleached groundwood pulp.

The testing procedure used was the same as that for the sulphite stocks previously reported (*1*). Stocks of 2, 3, and 4% consistency were prepared from dry lap soda pulp. Each of these consistencies, made from entirely fresh stock was pumped through the flow system maintaining the temperature within the range of 84 to 88 °F. The pressure at each of the four pressure taps, as transmitted through the air pressure balance system, was recorded as the stock velocity was increased from 1 to 10 f.p.s. The data were translated into friction curves, head loss per 100 ft. of straight pipe versus the flow velocity. Kraft pulp suspensions of 2, 3, and 4% consistencies were similarly studied, maintaining the temperature range of the stocks within the same limits. The unbleached groundwood pulp was pumped at only two consistencies, 2 and 3%, and at the same temperature as the others. The curves for each stock will be discussed later.

Student investigations, as special projects during the past school year had shown that the shear value of a given pulp decreased as the freeness, measured as Canadian standard freeness, decreased. This indicated that a close check of the freeness of the stock suspensions should be made during the pumping time. The freeness of each stock, therefore, was determined as soon as it was prepared. Periodically during the pumping of the stock, samples were taken and the freeness determined. Figure 1 shows the behavior of the freeness with pumping. It was necessary to recirculate the stock for nearly 2 hr. before taking data in order to adjust the temperature and insure the stock was uniform in consistency. Thus, it automatically resulted that each stock was pumped at nearly a uniform freeness as indicated in the more horizontal portion of the curves in Fig. 1 after the first 2 hr. of time.

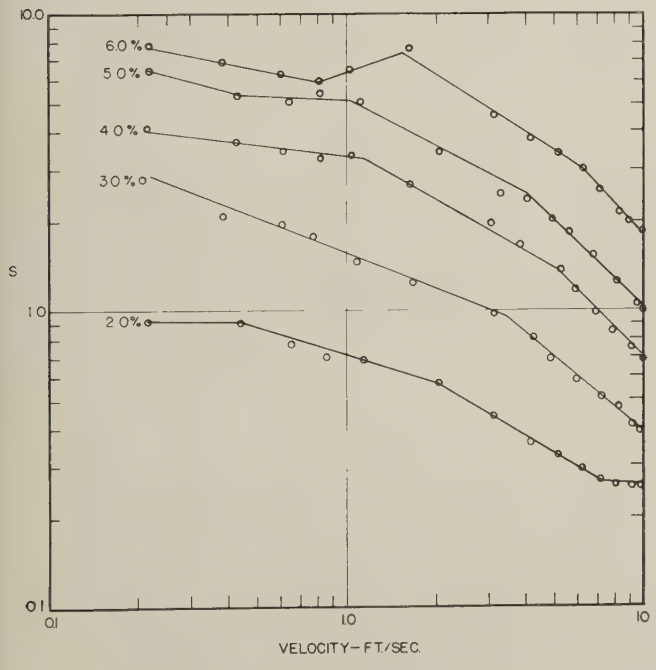

Fig. 3. Shear value versus rotor velocity for bleached sulphite stock

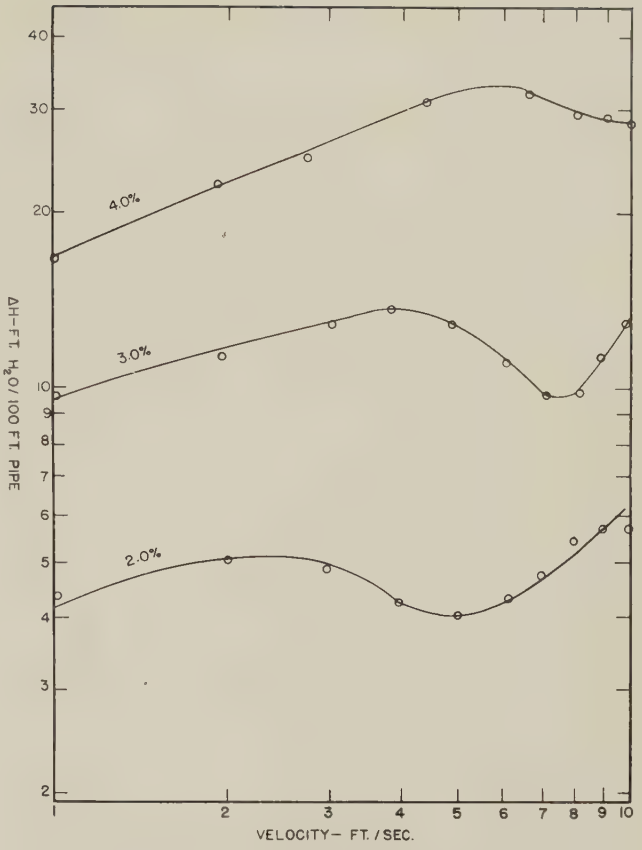

Fig. 4. Pressure drop–velocity relationships for unbleached Canadian kraft stock through 6.34-in. spiral-welded steel pipe

The shear value versus velocity curve of each consistency stock was determined using a quantity of the stock which had been circulated in the flow system. Thus there was no appreciable variation of freeness during the recording of friction head loss and shear value data. The shear diagrams were determined from data taken in the shear meter over the rotor peripheral speed range from 0.2 to 10 f.p.s. These curves also will be reviewed later.

The change in freeness observed for the kraft, soda, and groundwood pulps raised the question whether a similar change probably occurred with the continued recycling of the sulphite stock which had been studied previously. A pulp stock of approximately 3% consistency was made up using the bleached sulphite dry lap from which the first correlation was made. The stock was circulated through the flow system while samples were taken for freeness determinations. The results showed the freeness did decrease and therefore the shear value of the sulphite stock at the various consistencies should be redetermined on the stock of lower freeness. The shear values previously reported for this pulp had been determined on stock prepared from fresh dry lap. The shear diagrams for bleached sulphite stock included in this work were determined on the stock of reduced freeness.

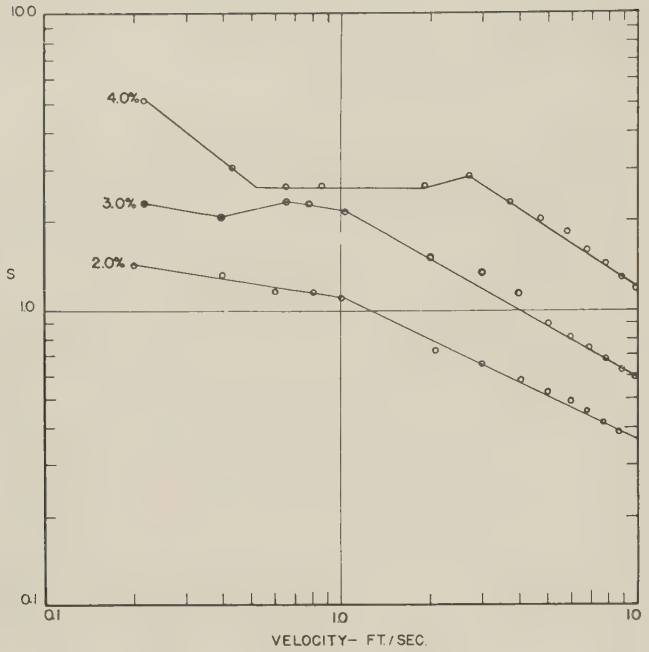

Fig. 5. Shear value versus rotor velocity for unbleached Canadian kraft stock

RESULTS AND DISCUSSION OF RESULTS

The results of the flow and shear studies are shown graphically in Figs. 2 to 10. The head loss curves for the bleached sulphite were reported previously (*1*). Attention is called to the relative magnitude of head loss at a given consistency for the four pulps in Fig. 10. At 2% consistency, bleached sulphite has the lowest head loss except at 2.2 and 10.0 f.p.s. velocity where the head loss for sulphite and soda are equal. At low velocities, up to 3 f.p.s., 2% groundwood is next in order of the four pulps, falling only slightly below 2% kraft. At 3 ft. the kraft curve with negative slope crosses the groundwood curve which does not show the maximum-minimum curve characteristics of the longer fibered pulps. The short fibered soda likewise does not show the double deflection in the head loss curve.

For the 3% stocks, soda has the lowest head loss for velocities up to 3.5 ft. where it crosses the 3% sulphite and continues to rise until it equals the minimum value for 3% kraft. The 3% groundwood not only is higher than the other 3% stocks but is even higher than the 4% sulphite head loss curve. It is obvious that fiber length alone is not a criterion of head loss, else there would not be the shifting of position of the head loss curves for the various stocks. Freeness likewise is not a criterion by itself of head loss. Considering kraft pulp of 800 freeness at 2%, sulphite of 600 freeness, soda with 460, and groundwood of 50 freeness, there is no relation of freeness to head loss for this variety of pulps.

Figure 11 is the correlation of the friction factor f with the suspension flow number N_{sf}. The data points represented on the graph were plotted for each pulp and each consistency by calculating values of the friction factor f from the measured head loss curves by the expression:

$$f = \frac{\Delta H_f D 2 g_c}{u^2 L} \qquad (1)$$

in which: f is the dimensionless friction factor, ΔH_f is the head loss in the pipe due to friction, feet of water per 100 ft. of straight pipe of diameter, D, in feet. The factor, $g_c = 32.2$ f.p.s. squared, converts the dimensions of force to dimensions of mass. Finally, u is the mass flow of stock in the pipe, feet per second, and L is the pipe length, 100 ft. to correspond to the units of ΔH_f. The suspension flow number was calculated using shear values by the expression:

$$\frac{Du\rho}{s} = N_{sf} \qquad (2)$$

The terms in the expression N_{sf} refer to the diameter of the pipe, D, in feet in which the stock is flowing at the velocity of u feet per second at a density of ρ, slugs per cubic foot. The shear value s has the units of pounds force, seconds per square foot. The shear force is taken from the shear diagram for the stock being studied at the rotor peripheral velocity equal to the stock velocity in the pipe, and at the same consistency. Thus the correlation is the graphical representation of the expression:

$$\frac{\Delta H_f D 2 g_c}{u^2 L} = f = \phi\left(\frac{Du\rho}{s}\right) \qquad (3)$$

A total of 130 data points are presented on the graph. The correlation is empirical, yet analysis of the deviations of the data points from the straight line drawn to represent them shows:

1. That 85% of the data points deviate less than 35% from the straight line.
2. The maximum deviation of any data point from the line is plus 87%. (The plus deviation indicates

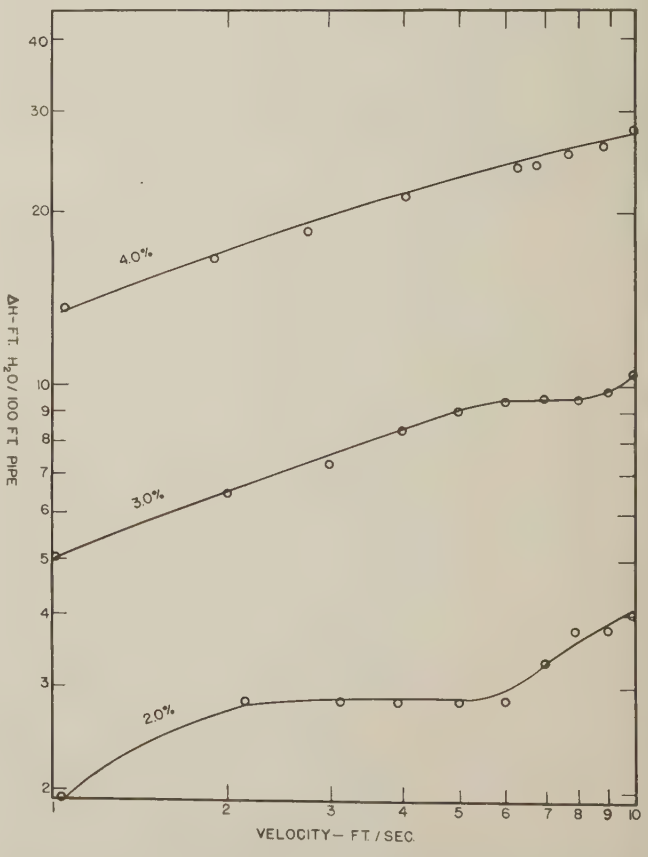

Fig. 6. Pressure drop–velocity relationships for bleached Duralba soda stock through 6.34-in. spiral-welded steel pipe

that the friction factor calculated from the flow data for that suspension flow number is higher than the friction factor which would be determined by the correlation line.)

3. The short fibered pulps, groundwood and soda, deviate above the line with the groundwood showing the greater deviation.

4. The long-fibered pulps, sulphite and kraft deviate below the line, minus deviations.

5. The plus deviations for the soda and groundwood pulps increase as the consistency increases.

6. The minus deviations for the kraft pulp decreases as the consistency increases; while

7. The deviations for the sulphite pulp do not show any fixed pattern of change with consistency.

APPLICATION OF THE CORRELATION

The correlation presented here which relates a property of pulp stock suspensions to pipe friction is offered as a means of estimating the pipe friction for a given stock flowing through a pipe system. The correlation was derived for the single pipe diameter of 6.343 in. It is believed that this will not be a limiting factor in the application of the correlation for predicting the friction loss in pipes of other diameters. Additional work testing the correlation using pipe of 12 in. diameter will be carried out during the coming year.

Studies are needed in which pipes of materials and surfaces different than the spiral-welded steel pipe used thus far would be tested. It is believed a limited amount of testing of other pipe should establish factors which could be used in the correlation to make pipe friction estimations with a high degree of accuracy for the pipes studied.

It is known that temperature variations affect the friction coefficients, but the magnitude of the effect is unknown. The temperature of the suspensions were maintained within the range between 84 and 88°F. in both the flow system and the shear meter for this investigation. Shear values drop with increasing temperature and the magnitude of the change could be readily determined. The magnitude of the change of pipe friction with temperature should also be determined. If the temperature coefficient were of the same order of magnitude in the shear meter and the pipe, temperature would then be a known variable which could be taken into consideration in pipe friction calculations. The correlation can now be used for predicting the friction loss of pulp suspensions flowing in smooth steel pipe within the narrow temperature limits given, for any pulp for which the shear diagram has been plotted.

Until the studies can be made relative to pipe diameter, pipe materials and surfaces, and temperature effects, the correlation should be used with consideration being given for these variables.

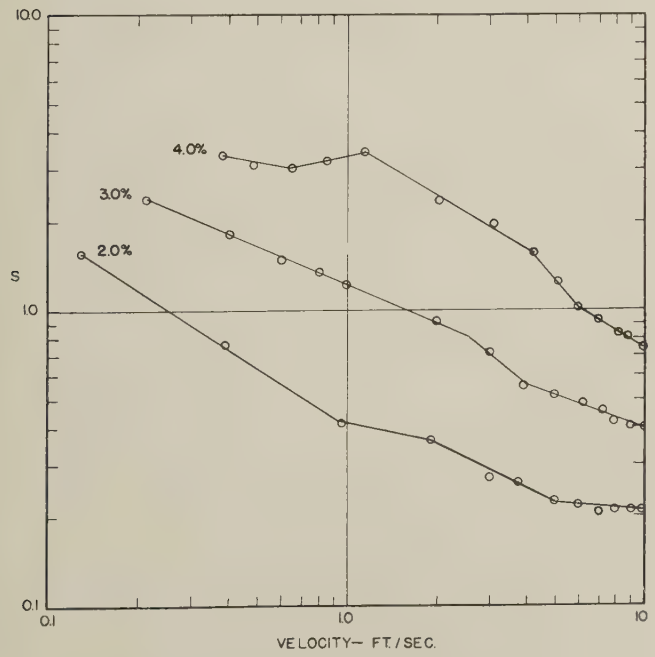

Fig. 7. Shear value versus rotor velocity for bleached Duralba soda stock

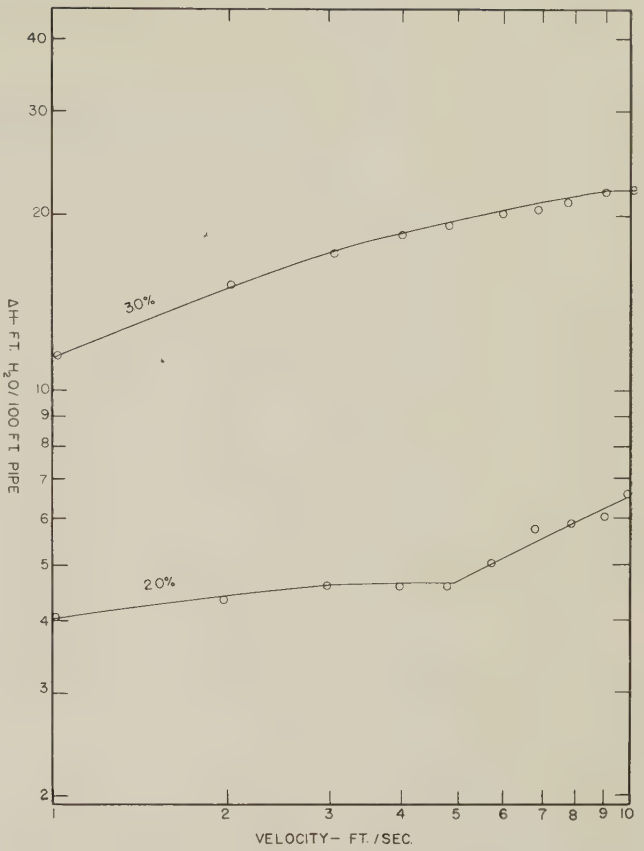

Fig. 8. Pressure drop–velocity relationships for groundwood stock through 6.34-in. spiral-welded steel pipe

ILLUSTRATIVE EXAMPLE, USING THE CORRELATION

What friction pressure drop may be expected, expressed in feet of water per 100 ft. of straight pipe, when an unbleached kraft pulp of 4.0% consistency is pumped through an 8-in. i.d. welded steel pipe at 6 f.p.s. velocity?

Solution. The shear value for unbleached kraft pulp of 4.0% consistency at a shear meter rotor velocity of 6 f.p.s. is 1.7. The N_{sf} calculated from equation 2 is 4.5. Using the correlation chart the friction factor corresponding to this N_{sf} is found to be 0.23. Substituting in equation 1 and solving for ΔH_f the friction head loss per 100 ft. of straight pipe is found to be 19.5 ft. of water.

SUMMARY

The experimental investigation of the flow of pulp

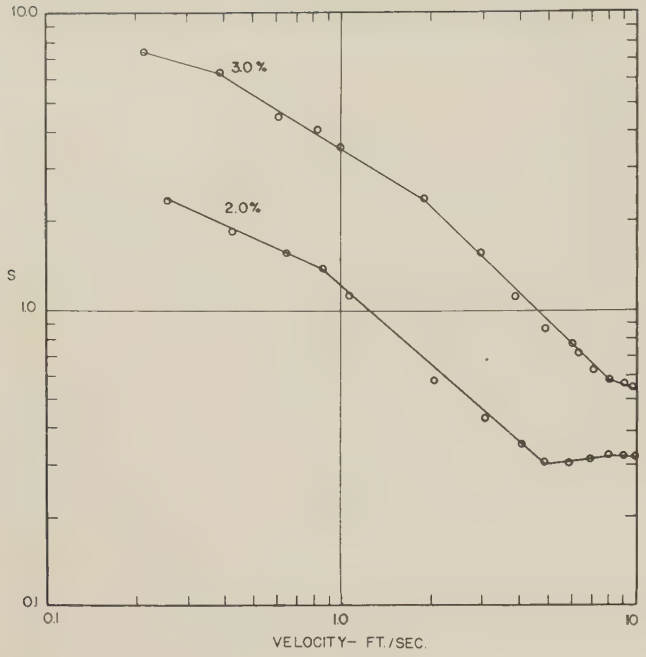

Fig. 9. Shear value versus rotor velocity for groundwood stock

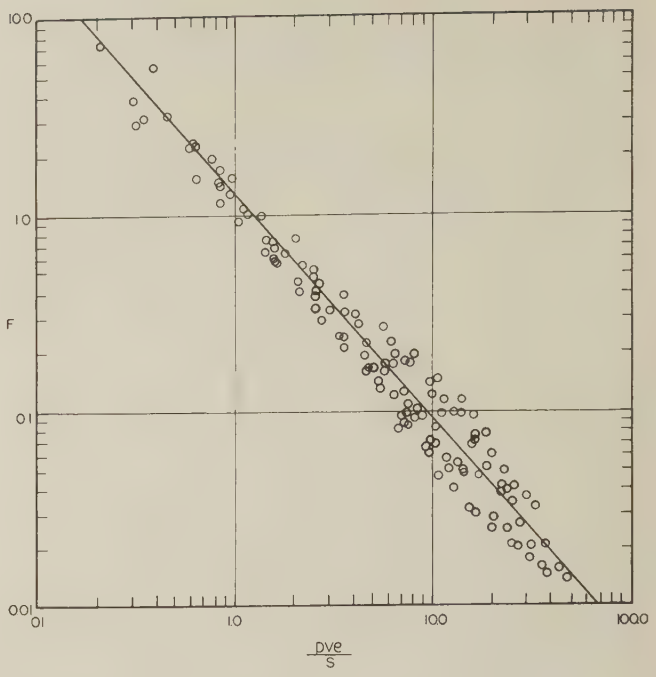

Fig. 11. Friction factor versus suspension flow number for all pulps studied

stocks in pipes and the measurement of the property of those pulp stocks defined as shear value, which has been carried on at the University of Maine for the past 2 years can be summarized in this one pertinent conclusion. Considering the four pulps studied, a northern kraft, magnesium-base sulphite, hardwood soda, and groundwood, a correlation has been established between the shear value of the pulp stocks and the measured pipe friction head loss. The correlation was established on pipe flow data using a nominal 6-in. spiral welded steel pipe test section with extended calming sections. The pulps were pumped at several consistencies over a mass flow rate from 1 to 10 f.p.s. The correlation holds within 35% for at least 85% of the test conditions. It is believed the correlation can be used for pipes with other than 6 in. diameters, however this point remains to be proved. The correlation can be used for any pulp whose shear value has been determined in a manner consistent with that described in this and other papers by the authors.

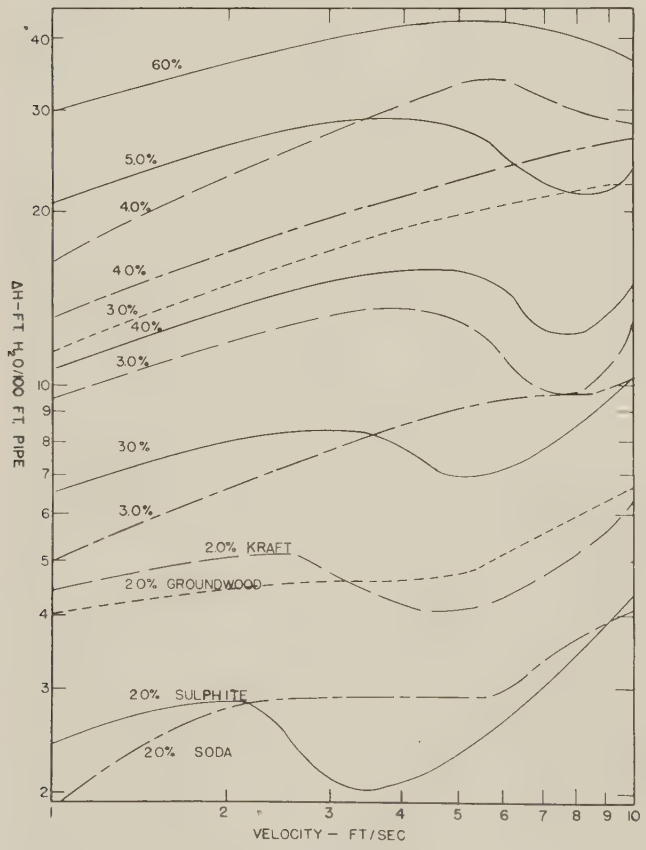

Fig. 10. Pressure drop–velocity relationships for all pulps studied

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RECEIVED Dec. 13, 1954. Presented at the Ninth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Philadelphia, Pa., Oct. 18–21, 1954.

Chlorine Dioxide and Safety

J. F. HALLER and W. W. NORTHGRAVES

Some physical properties of chlorine dioxide are described. The decomposition temperature and the rate of propagation of chlorine dioxide explosions have been determined. Decomposition pressure may be safely dissipated in properly designed equipment. Chlorine dioxide is not toxic in tolerable concentrations.

THE last few years have seen a tremendous surge of interest in chlorine dioxide on the part of the pulp industry. This is emphasized by the fact that approximately 25 mills in the United States and Canada are bleaching with chlorine dioxide or are definitely planning such installations.

The excellent properties of this unusual bleaching agent have long been known, but it is only in the last few years that practical, economical, and safe processes have been available to the industry for large scale production of chlorine dioxide at the point of use (*1*).

General acceptance of chlorine dioxide has been delayed for three reasons:

1. Market conditions have not until recently justified the additional cost of producing extremely bright and strong pulp.
2. Processes for making chlorine dioxide, as mentioned above, were not available.
3. There has been a widely held belief that chlorine dioxide is an extremely hazardous material.

Many years of experience with chlorine dioxide at Olin Mathieson have led to the conviction that the properties of chlorine dioxide are not widely understood, and that this lack of understanding has resulted in overemphasis upon the hazards relative to the manufacture and use of this compound.

The properties of chlorine dioxide with special emphasis upon decomposition hazards and general statements concerning toxicity are herein noted.

PROPERTIES

Chlorine dioxide is a yellow-green to orange gas, its color changing with increasing concentration. It has a disagreeable odor similar to chlorine and somewhat resembling ozone. Upon cooling it forms a red, unstable liquid which freezes at −59°C. and boils at 11°C. (*2*).

Chlorine and oxygen are the normal products of decomposition.

The density of liquid chlorine dioxide is given in Table I (*3*).

Over the liquid range, the density d of chlorine dioxide at t°C. is:

$$D = -0.00945t + 1.587$$

The density of chlorine dioxide gas is given as 2.330 and 2.3984 at 11°C. (*4*).

The solubility of chlorine dioxide in water at various partial pressures is shown in Fig. 1 (*3*). The solubilities at 0, 15, and 30°C. were found to be linear, therefore the values for intermediate temperatures were interpolated.

The solubility of chlorine dioxide in water as given in the "Encyclopedia of Chemical Technology" (*5*) is shown in Table II.

Solutions of 8 grams per liter chlorine dioxide in water may readily be prepared for large scale bleaching of pulp.

EXPLOSION HAZARDS

It has been stated without qualification that chlorine dioxide in concentrations over 10% is spontaneously explosive (*6*). This is obviously incorrect since, as pointed out above, 100% concentration does exist.

It has also been stated that 10% concentrations explode quite violently when initiated with a spark (*7*).

Olin Mathieson Chemical Corp. has been producing chlorine dioxide for sodium chlorite manufacture for about 20 years, and originally operated a chlorine dioxide generator at 30 mm. Hg partial pressure (4% ClO_2). When it became necessary to expand production, the advantages of operating at higher concentrations necessitated a study of chlorine dioxide and its decomposition.

A research program was planned to study the decomposition of chlorine dioxide and to determine whether its explosions could be controlled and rendered harmless, thus permitting the use of higher chlorine dioxide concentrations with resulting increase in plant capacity.

The problem involved two distinct factors: (1) the conditions of initiation of the explosion, and (2) the conditions of propagation of the explosion. These were investigated separately (*3*).

TEMPERATURE OF INITIATION OF EXPLOSION

Chlorine dioxide mixed with air in various proportions was generated at 27°C. The gas was introduced into a glass tube 20 mm. diameter by 150 mm. long closed with a loose wad of glass wool. A thermometer well was introduced into the tube near the bottom, and was heated by nichrome wire wound around the bulb and coated with a thin film of sodium silicate. The tube was filled with gas flowing gently and the temperature was very slowly raised until audible and visible explosion occurred. The glass wool plug was usually displaced, but no breakage occurred.

The temperature of ignition at various partial pressures was observed and corresponding samples were alternately drawn and analyzed. The observed values of partial pressure of chlorine dioxide and corresponding ignition temperature are shown in Fig. 2. These values are not highly consistent and suggest that an appreciable lag between filament temperature and ther-

J. F. HALLER, Assistant Director of Research, Research Division, Niagara Falls, N. Y., and W. W. NORTHGRAVES, Technical Service Representative, Industrial Chemicals Division, Olin Mathieson Chemical Corp., Baltimore, Md.

mometer reading existed in spite of precautions. Nevertheless, they show that between 100 and 300 mm. the ignition temperatures all lie in the vicinity of 130°C.

The foregoing experiments were made in a system substantially free from impurities. It has been shown

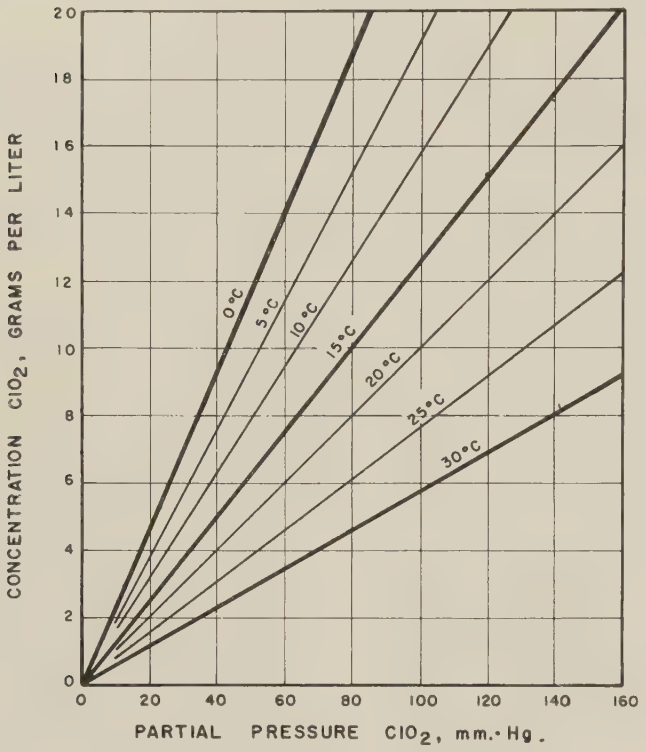

Fig. 1. Solubility of chlorine dioxide in water

(*3*) that light, oxidizable materials such as dust; petroleum-base lubricants and organic compounds in general; sulphur; etc., lower the decomposition temperature of chlorine dioxide.

There will be practically no explosions in a clean system, even when generating 20% chlorine dioxide by volume. If new equipment is not free from oxidizable impurities, there may be occasional mild explosions during the start-up period. These will diminish in frequency after a few weeks and finally cease almost completely. Such explosions as may occur are harmless in a generator of the Olin Mathieson design.

Filtering of all feed streams, and the use of proper pump and valve packing, have been shown to be extremely important when operating at concentrations in excess of 10% ClO_2.

RATE OF EXPLOSION PROPAGATION

Chlorine dioxide diluted with air and provided with a means of sampling was introduced into a rate apparatus. This consisted of 40 ft. of 6-mm. diameter

Table I. Density of Liquid Chlorine Dioxide

Temperature, °C.	*Density, g./ml.*
−60	1.973 (frozen)
−33	1.907
−21	1.788
−17	1.735
+ 5	1.635

Table II. Solubility of Chlorine Dioxide in Water

Temperature, °C.	*Partial pressure, mm. Hg*	*Solubility, g./l.*
25	34.5	3.01
25	22.1	1.82
25	13.4	1.13
25	8.4	0.69
40	56.2	2.63
40	34.3	1.60
40	18.9	0.83
40	9.9	0.47
60	105.9	2.65
60	53.7	1.18
60	21.3	0.58
60	12.0	0.26

glass tubing coiled in a thermostatically controlled water bath, the ends of which terminated in the middle of glass cylinders 12 mm. diameter by 80 mm. long. One end of each cylinder was sealed. The other end was closed by a ground-on glass plate supported by a spring and provided with electrical contact points so that when it opened under explosion pressure a circuit was closed. One of the cylinders was provided with a platinum wire spark gap which could be operated from a small induction coil.

The electrical contacts activated a recording pen which traveled on a revolving drum at known speed. In operating, the tube and cylinders were filled completely with gas, the system closed, and the gas ignited by the spark. Initiation of the explosion in the first cylinder was recorded on the drum, and a small point of flame was observed to travel around the spiral tube and then into the second cylinder. Its arrival was also recorded on the drum. Knowing the speed of the drum, separation of the initial and final marks, and the length of the explosion path, the rate of propagation was readily obtained.

With gas at 27.5°C. a linear relationship between the partial pressure and the rate of flame propagation was observed for concentrations up to 300 mm. (40% ClO_2). Upon raising the partial pressure a few millimeters

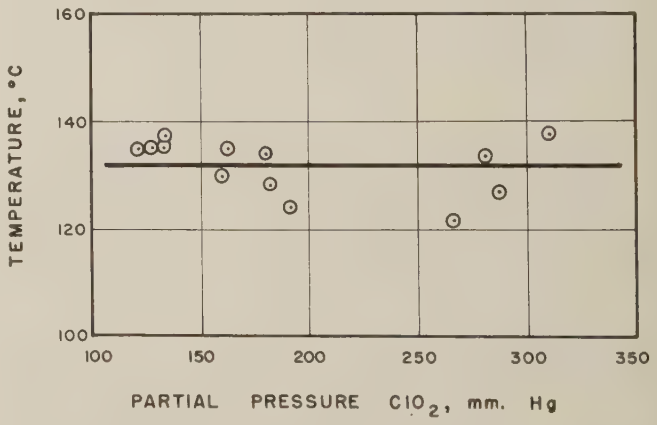

Fig. 2. Temperature of initiation of explosion of chlorine dioxide

above 300, the explosions in the first cylinder, last cylinder, and the coils of tubing were apparently simultaneous, showing that a detonating type of propagation was suddenly reached.

The above data, along with that obtained at 40 and 60°C., are shown in Fig. 3.

It is interesting to note that even the detonating explosions did not break the glass apparatus. The generator was protected by a spring-closed plate cover and detonating concentrations in the generator were deliberately exploded without breakage, the valve merely opening to relieve the sudden pressure and then closing to continue operation.

Although it was recognized that wall effects might have an appreciable bearing upon the results obtained in small laboratory apparatus, it was felt that chlorine dioxide generation equipment could be designed from these experiments so that explosions would not be dangerous. This was confirmed in a 1500-lb. per day chlorine dioxide pilot generator and two 8000-lb. per day production units in the Niagara Falls plant of Olin Mathieson Chemical Corp. In these units, explosion relief area of approximately 0.09 sq. ft. per cu. ft. of gas volume has been found entirely adequate for operation up to 20% ClO_2. This design is being followed in the many 6000-lb. per day Mathieson chlorine dioxide generators now being built for the pulp industry (*8*).

To further illustrate the nature of the decomposition of chlorine dioxide–air mixtures, some qualitative experiments were performed.

A glass tube 30 mm. diameter and 1 meter long was filled with chlorine dioxide at a series of partial pressures up to 100 mm. One end was closed and the other loosely stoppered with glass wool. The gas could be ignited at either end. Upon ignition, a weak flame was observed to sweep through the tube. At lowest concentrations there was little or no audible report but the

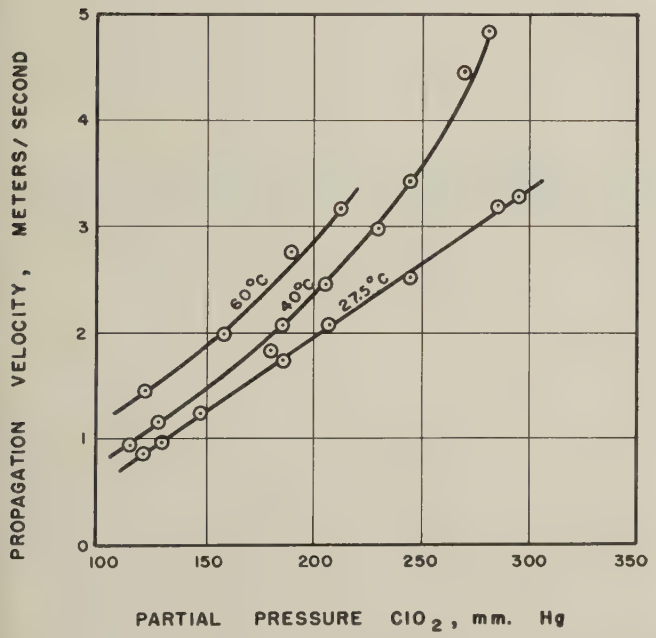

Fig. 3. Effect of partial pressure of chlorine dioxide on its flame propagation velocity

color disappeared. At higher concentrations in which a noise occurred, the explosion was considerably sharper when ignited at the open end rather than the closed end, since the compression wave visibly expelled gas without ignition in the latter case.

A tapered tip placed upon the end of a delivery tube allowed chlorine dioxide at 70 mm. partial pressure to be ignited. This burned steadily as a pinkish stationary flame. Upon reduction of the gas velocity the flame was made to enter the tip and burn within the delivery tube. On careful adjustment of the velocity the flame could be made to advance, retreat, or stand still. A narrow orifice served as a flame arrester with sufficient velocity at partial pressures up to 150 mm.

A 4-liter beaker was covered with a card and filled with gas at 200 mm. partial pressure (26% ClO_2). Upon ignition, there was a soft explosion which threw off the cover but did not break the beaker.

From the foregoing discussion, it will be seen that the decomposition of chlorine dioxide at concentrations well over 20% results in an explosion of a very low order indeed. For this reason, it is preferred to call it a "puff." Such a term is more truly descriptive and in conformation with the facts.

Chlorine dioxide as produced in the pulp mill is always diluted with air or nitrogen and will contain varying amounts of chlorine, hydrogen chloride, and carbon dioxide, depending upon the type of generation process used. It has been shown (*3*, *9*), that oxygen, chlorine, carbon dioxide, and hydrogen chloride do not affect the stability of chlorine dioxide; they act only as diluents.

The Mathieson chlorine dioxide generators referred to above are the sodium chlorate–sulphur dioxide–sulphuric acid type. These contain a large mass of reaction liquor and are provided with an adequate cooling jacket. Heat capacity is very large and the temperature is very easily controlled. If cooling water were turned completely off, it is estimated that the reactor temperature would not rise more than 10 or 15°C. per hr. from the normal operating temperature of about 30°C.

In dry generators of the sodium chlorite–chlorine type, temperature control is much more difficult and it is recommended that the concentration of chlorine dioxide should not exceed 10%, with 4 to 5% probably being a desirable operating level (*2*).

Table III. Effect of Chlorine Dioxide Upon Guinea Pigs

Animal No.	*Concentration ClO_2, p.p.m.*	*Exposure period, min.*	*Results*
1	1000	3	Died after removal from gas
2	70–500	38	Died after removal from gas
3	0.5–351	Av. 5 hr./day for 7 days	Died after removal from gas
4	150	44	Died in gas
5	150	5	Recovered
6	150	15	Recovered

Table IV. Exposure Record of Animal No. 3

Day	*Concentration ClO_2, p.p.m.*	*Exposure, hr.*
1	0.5	5.0
2	3.0	2.5
3	2.3	6.5
4	3.0	2.0
5	...	...
6	6.0	5.0
7	14–17	6.0
8	45	0.67
8	351	0.75

TOXICOLOGY

There is considerable disagreement among literature sources concerning the toxicity of chlorine dioxide.

Sax (*10*) gives 1 p.p.m. as the maximum allowable concentration in air and states that chlorine dioxide is "definitely irritating" at 500 p.p.m. (At this concentration it would be intolerable and probably rapidly fatal—*Authors.*)

Elkins (*11*) estimates 1 p.p.m. as the maximum allowable concentration for working conditions, and states that 5 p.p.m. was found to be definitely irritating. Two cases of illness, one fatal, were reported in the paper industry. It was stated that 19 p.p.m. inside a bleach tank probably exceeded the concentration causing the death of one worker.

Observations at Olin Mathieson (*3*) indicate that the odor of chlorine dioxide is apparent at 17 p.p.m. and that at 45 p.p.m. it irritates the eyes and nose. Studies on guinea pigs showed that 350 p.p.m. was rapidly fatal, 150 p.p.m. caused death in 44 min., while 45 p.p.m. and less did not cause death in several hours' exposure.

Table III summarizes a series of experiments performed on guinea pigs.

It is interesting to note that animal no. 3 survived progressively increasing concentrations of chlorine dioxide over a period of 1 week. The record of exposure is detailed in Table IV.

It will be seen that the animal lived for 1 week while exposed for 2 to 6 hr. per day to concentrations of chlorine dioxide up to 17 p.p.m.

In another series of experiments rats were given water containing 10 p.p.m. chlorine dioxide as their only drinking water for a period of 2 years. The animals exhibited no difference in health or mortality compared to control rats drinking distilled water over the same period. Rats drinking water containing 100 p.p.m. chlorine dioxide did show a higher mortality rate at the end of the 2-year period.

Adequate ventilation and personal protective equipment should be provided in areas where chlorine dioxide is made and used.

Olin Mathieson personnel are supplied with a chlorine-type breathing cannister and mouthpiece, which they use at their discretion. Self-contained respiratory equipment of the Scott Air Pak type is available for emergency use.

In 20 years' experience at Olin Mathieson, there has been no indication of cumulative effects; exposure to chlorine dioxide has resulted only in temporary discomfort.

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Comparative Analysis of Digester Corrosion Measurements

TAPPI Digester Corrosion Subcommittee Summary Report No. 2

N. SHOUMATOFF and H. O. TEEPLE

An industry-wide survey of alkaline digester corrosion is concluded with additional data and re-examination of data previously used. Statistical errors of thickness measurement in different mills are compared. Localized attack is analyzed in relation to liquor circulation and heating. Revised estimates of prevalent corrosion rates for carbon steels and alloys are presented. Corrosion rate trends and fluctuations are investigated and compared with process variables.

This report presents the second and final part of a survey of alkaline digester corrosion begun in 1953. The study is based on wall thickness data, available in large quantities from routine inspections by individual mills using modern nondestructive techniques. In addition to the 37,000 readings assembled in 1953, 18,000 new readings have been collected and analyzed. Also, further calculations on the original 37,000 have been carried out by Armour Research Foundation under TAPPI Research Grant No. 71. In spite of the extensive information and careful analysis, the first part of the survey fell somewhat short of expectations, as has been recorded (*1–6*), and it is attempted here to overcome these deficiencies as far as possible. The general objectives are to establish on quantitative grounds the status of the digester corrosion problem, its historical trend, and its correlation with construction and operating factors.

To clarify the significance of apparently inconsistent individual results, such as those underscored by Peters (*6*), a special study has been made of statistical variations in the data. Determination was made of the residual standard deviations of the Audigage thickness measurements in each of the 89 digesters included in the 1953 survey. These were calculated by eliminating nine assignable causes of variation in the data,

N. Shoumatoff, West Virginia Pulp & Paper Co., New York, N. Y., and H. O. Teeple, International Nickel Co., New York, N. Y.

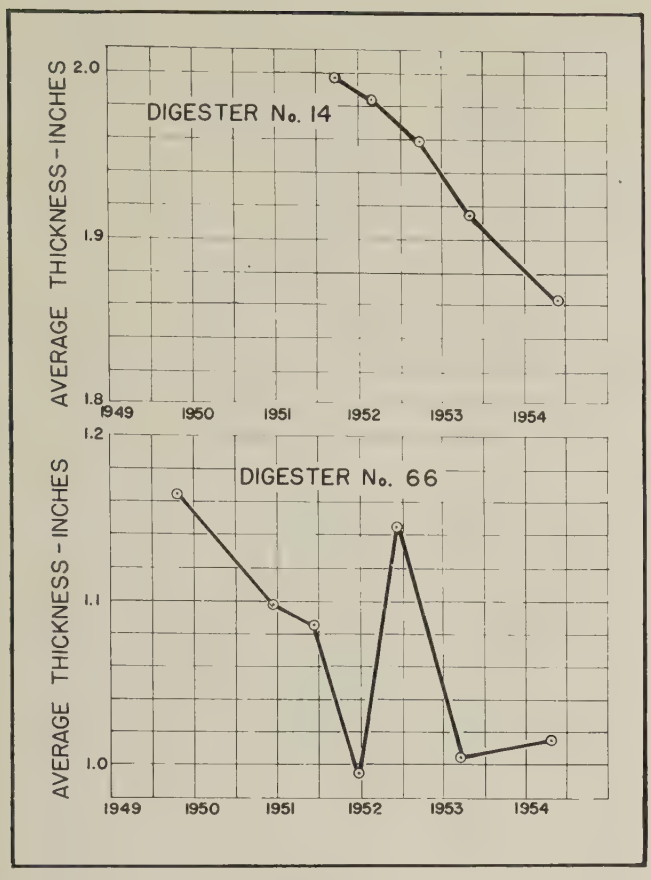

Fig. 1

and the residual thus obtained is an estimate of the experimental error of each reading (7).

It was determined that the median residual standard deviation for the 89 digesters was 0.029 in., while the median value for eight alloy digesters was 0.016 in. Tables I and II show that the standard deviations for

Table I. Residual Standard Deviations in Individual Digesters

Range, in.	*No. digesters*
0.000–0.009	7
0.010–0.019	13
0.020–0.029	28
0.030–0.039	13
0.040–0.049	8
0.050–0.059	11
0.060–0.069	3
0.070–0.179	6

individual digesters are sharply clustered in the range of 0.02 to 0.03 in. However, there is a considerable group having higher standard deviations, and it may be seen from Table II that most of these are located in two of the 12 pulp mills. The six vessels with standard

Table II. Residual Standard Deviations Grouped By Mill Medians

Inches	*Mills*	*Digesters*
0.000–0.009	0	0
0.010–0.019	2	17
0.020–0.029	6	28
0.030–0.039	1	4
0.040–0.049	2	38
0.050–0.059	0	0
0.060–0.069	0	0
0.070–0.079	1	2

Table III. 95% Confidence Range ($L_2 - L_1$) for Average Corrosion Rate of Typical Digester

Residual standard deviation = 0.029 in.
Number of inspection points = 160
Frequency of inspection = 6 months

No. of inspections	$(L_2 - L_1)$, *i.p.y.*
2	0.026
3	0.013
4	0.008
5	0.006
6	0.004
7	0.003
8	0.003

deviation in excess of 0.08 in. have been arbitrarily eliminated from any further use in the corrosion rate comparisons. Data from the remaining vessels with lower standard deviation make possible useful comparisons if the statistical variations are born in mind. Table III gives the confidence limits for the average corrosion rate of a typical digester and it may be seen how the precision increases with the number of inspections.

A comparison was made between the measurements taken on 15 digesters before they went into service and the nominal thicknesses of these digesters. The average excess of the measured thicknesses was 1.7% and the extreme values of the average thicknesses for individual vessels varied from −4.3% to +6.6% of the nominal. These figures compare with allowable excess ranging from 2.5 to 7% (American Iron and Steel Institute).

A plot of thickness versus time for two digesters (Fig. 1) shows how much easier it is to interpret precise readings (digester no. 14, standard deviation 0.012 in.) as compared with relatively imprecise readings (digester

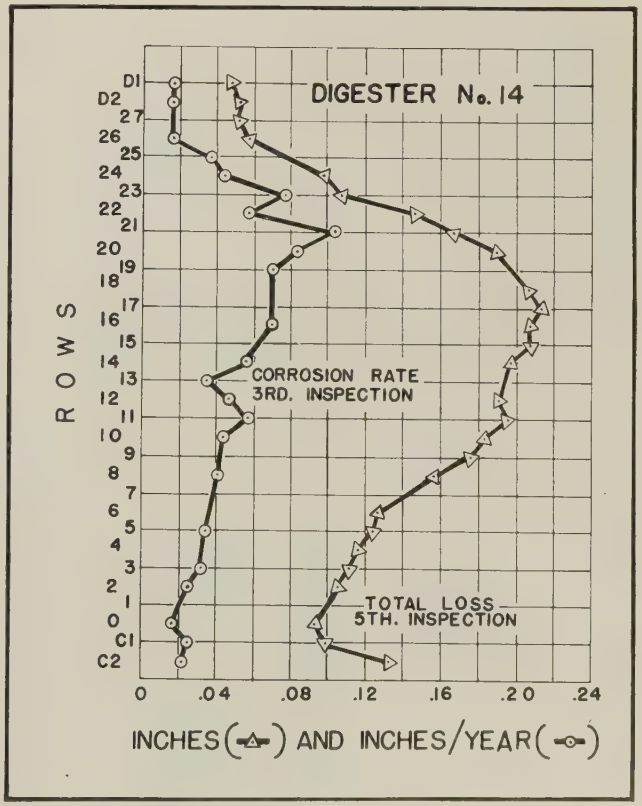

Fig. 2

Table IV. Summary of Carbon Steel Current Corrosion Rates Used for Comparisons Based on Actual Measurements

Mill	Digester	Steel specification	Date installed	Number of inspections	Corrosion rate period	Method of calculation	Corrosion rate, i.p.y.
F	61	S-1	12-37	6	9-49 to 8-52	Least squares	0.011
	62	A-70	12-42	6	4-49 to 5-53	Graphical	0.014
	63	A-70	12-42	8	10-49 to 3-54	Graphical	0.010
	64	A-70	10-47	6	11-50 to 2-53	Graphical	0.034
	65	A-70	10-47	8	11-50 to 4-53	Graphical	0.035
	66	A-285C	9-48	7	12-50 to 4-54	Graphical	0.024
	67	A-285C	9-48	5	6-52 to 4-52	Graphical	0.023
	68	A-285C	7-48	5	6-52 to 4-54	Graphical	0.028
	49	A-285C	3-51	6	7-52 to 6-54	Graphical	0.026
	53	A-285C	3-51	5	12-51 to 6-54	Graphical	0.024
	60	A-285C	5-51	5	5-51 to 5-54	Graphical	0.028
	F-1	A-285B	5-52	3	5-52 to 4-54	Graphical	0.042
	F-2	A-285B	5-52	3	5-52 to 3-54	Graphical	0.027
	42	A-212B	3-50	4	5-51 to 10-53	Graphical	0.048
	47	A-212B	3-50	4	5-51 to 1-53	Least squares	0.060
	54	A-212B	3-50	5	3-50 to 4-54	Graphical	0.046
S	S-1	A-70	6-37	3	9-52 to 4-54	Graphical	0.040
	S-2	A-70	6-37	3	10-52 to 3-54	Graphical	0.037
	S-3	A-70	6-37	3	11-52 to 5-54	Graphical	0.049
	S-4	A-70	6-37	3	11-52 to 5-54	Graphical	0.058
	S-5	A-70	6-37	3	11-52 to 5-54	Graphical	0.062
	S-6	A-70	2-42	3	12-52 to 3-54	Graphical	0.022
	S-7	A-70	2-42	2	1-53 to 4-54	Difference	0.058
	S-8	A-70	6-47	3	1-53 to 5-54	Graphical	0.059
	S-9	A-212B	12-50	2	1-53 to 11-53	Difference	0.040
	S-10	A-285C	5-52	2	1-53 to 11-53	Difference	0.032
H	77	A-89A	10-29	6	7-51 to 1-54	Graphical	0.005
	78	A-89A	10-29	6	7-51 to 1-54	Graphical	0.006
	79	A-70	10-30	6	7-51 to 1-54	Graphical	0.003
	74	A-285C	2-51	6	7-51 to 1-54	Difference	0.007
	73	A-285B[a]	11-51	5	1-52 to 1-54	Difference	0.006
	72	A-285B[a]	4-52	4	4-52 to 12-53	Difference	0.013
C	13	A-70	7-45	7	3-49 to 10-50	Least squares	0.045
	15	A-70	7-45	8	3-49 to 11-50	Least squares	0.049
	17	A-70	8-45	7	3-49 to 11-50	Least squares	0.044
	22	A-285B[a]	2-51	4	1-52 to 4-54	Difference	0.036
	14	A-285B[a]	3-51	5	9-51 to 5-54	Graphical	0.049
	16	A-285B[a]	3-51	4	1-52 to 6-54	Difference	0.055
	21	A-285B[a]	12-51	4	1-52 to 2-54	Difference	0.058
	20	A-285B[a]	1-52	4	1-52 to 2-54	Difference	0.077
	23	A-285B[a]	2-52	4	2-52 to 5-54	Difference	0.055
	C-1	A-285B[a]		2	7-53 to 7-54	Difference	0.052
V	V-1	A-285C	4-52	2	6-53 to 2-54	Difference	0.008
	V 2	A 285C	4-52	2	7-53 to 2-54	Difference	0.006
	V-3	A-285C	4-52	2	7-53 to 2-54	Difference	0.000
	V-5	A-285C	2-52	2	7-53 to 2-54	Difference	0.001
	V-7	A-285C	8-51	2	7-53 to 2-54	Difference	0.007
	V-8	A-285C	8-51	2	7-53 to 2-54	Difference	0.005

[a] Special rimmed type.

no. 66, standard deviation 0.044 in.). Figures 2, 3, and 4 illustrate how with precise data it is possible to obtain a reliable analysis of internal corrosion patterns. The vertical and horizontal corrosion profiles calculated by the Armour Research Foundation on digester no. 14 are compared with total thickness loss after two more sets of readings. The profiles suggest a large corroded area in the middle of the digester and its actual outlines are clearly shown in the chiaroscuro diagram of Fig. 4. This topological technique was borrowed from a study of basis weight variations (*5*). To obtain data of maximum precision and usefulness, pulp mills are urged to use the methods given in TAPPI Monograph No. 12 (*8*).

The explanation of localized corrosion, such as that in digester no. 14, undoubtedly requires careful study of mechanical details and operating procedure in each individual case, which is beyond the scope of this survey and is the responsibility of the various mills. For example, in this digester, which is a stationary vessel

Table V. Summary of Alloy Corrosion Rates

Digester	Mill	Alloy construction	Date installed	Number of Audigage inspections	Number of magnetic inspections	Method of calculation	Corrosion rate, i.p.y.
44	F	20% Inconel clad	2-51	4	2	Graphical	0.007
51	F	20% Inconel clad	1-51	4	1	Graphical	0.013
56	F	20% Inconel clad	6-51	3	1	Graphical	0.018
X4	F	20% Inconel clad	12-52	1	2	Difference	0.000
X13	F	20% Inconel clad	12-52	1	2	Difference	0.000
18	C	10% Inconel clad	12-50	6	...	Graphical	0.001
58	F	20% 316-SS clad	10-50	4	1	Graphical	0.012
S-10	S	7/64 in. 316-SS (cone)	5-52	...	2	Difference	0.000
S-9	S	7/64 in. 347-SS (cone)	12-50	...	2	Difference	0.000
M-6	M	10% 347-SS (cone)	1-51	...	2	Difference	0.000
99	Q	10% 347-SS clad	6-49	2	...	Difference	0.028
100	Q	10% 347-SS clad	6-49	2	...	Difference	0.025
12	C	10% 410-SS clad	3-50	5	...	Graphical	0.015

Table VI. Alkaline Digester Corrosion Rates

Range, i.p.y.	No. digesters	
	Carbon steel	Alloy
0.000–0.009	17	7
0.010–0.019	13	4
0.020–0.029	16	2
0.030–0.039	11	...
0.040–0.049	16	...
0.050–0.059	8	...
0.060–0.069	3	...
0.070–0.079	2	...

with natural circulation and direct heating, the pattern observed is most likely correlated with the chip loading and/or liquor filling systems (*10, 11, 12*). The use of average corrosion rates to evaluate factors such as circulation and heating, as was done in the first summary report, is not correct. To evaluate these factors one must consider localized corrosion, and not so much its absolute magnitude as its relative intensity for each digester. Revised comparisons for the various digesters using this new criterion are summarized in Table XV. The ranges of variation are overlapping and of unequal size due to the unequal representation in the two categories. However, the median values suggest that forced circulation causes accelerated attack in the upper parts of the digesters, and steam inpingement in the lower portions, although the table shows a new classification, based on review of the original records, so that the methods of circulation and heating are not independent of each other. In interpreting this table it should be understood that there is a strong negative correlation (0.65) between the average corrosion rates and the localized attack ratios.

On the other hand, average corrosion rates for the complete thickness traverses in each digester do have a legitimate place in studying factors primarily concerned

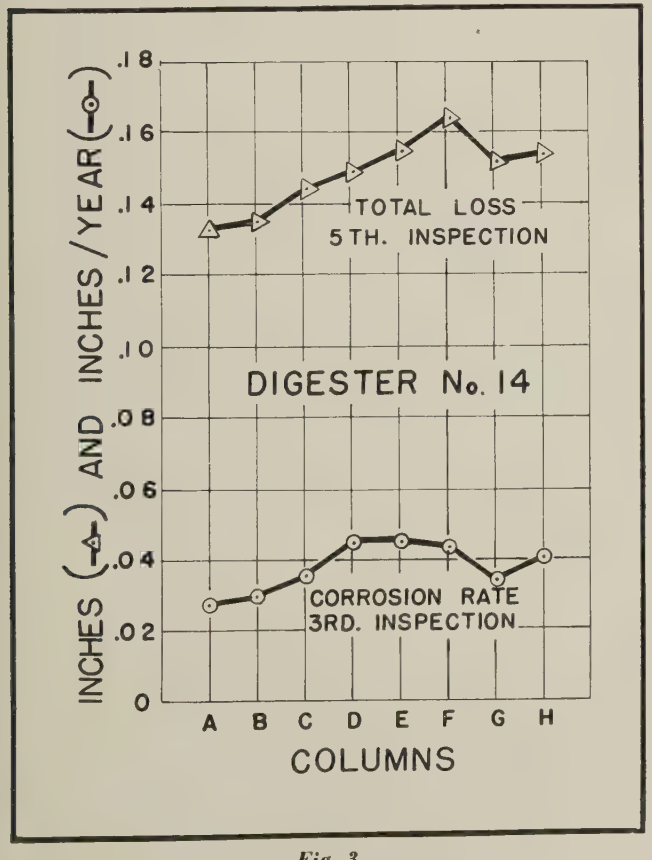

Fig. 3

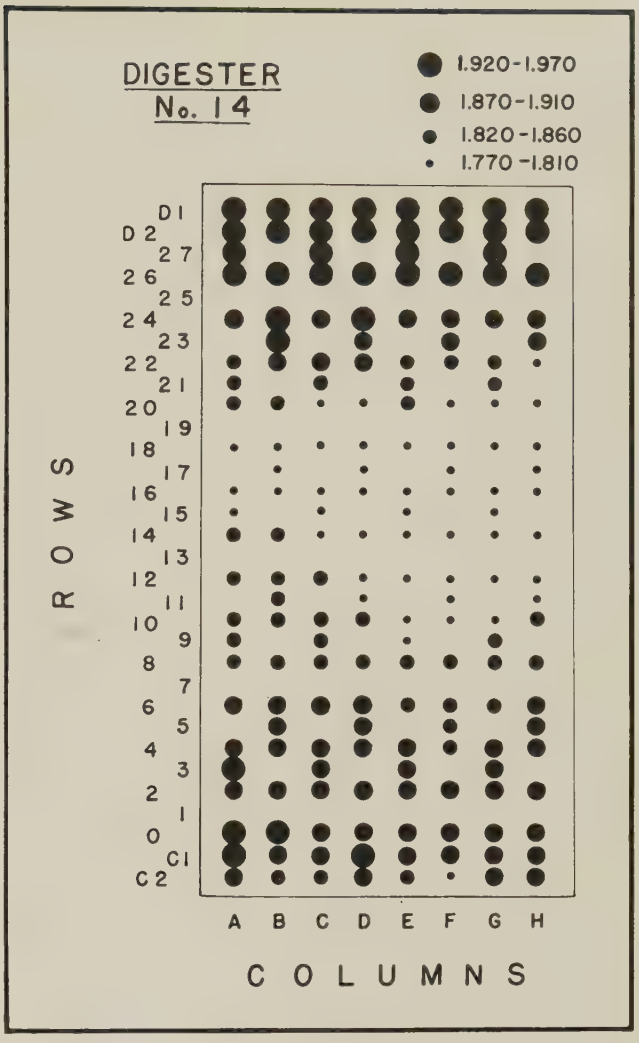

Fig. 4

with over-all corrosion performance, and are used in the balance of this report to evaluate materials of construction, historical trends, and process chemistry. However, the information on statistical variability suggests that arithmetic averaging of the results for more than one digester should be avoided, to reduce the possibility of distortion due to abnormal values. Instead, the results are presented in terms of frequency distributions, ranges, and median values. These simplified criteria facilitate direct interpretation, while by-passing the theoretical difficulties of determining nonhomoscedastic statistical significance (*5*).

Using the graphic technique of Fig. 1, together with exhaustive numerical analysis in the light of new data, revised comparative current corrosion rates corresponding to the various materials of construction have been determined. The new results are shown in Tables IV and V. A recapitulation of corrosion rates for 97 indi-

Table VII. Carbon Steel Alkaline Digesters, Corrosion Rates Grouped by Mill Medians

I.p.y.	Mills	Digesters
0.000–0.009	2	12
0.010–0.019	4	20
0.020–0.029	2	18
0.030–0.039	2	10
0.040–0.049	2	14
0.050–0.059	2	12

Table VIII. Carbon Steel Corrosion Rates, Old, New, and High Tensile

Tensile, p.s.i.-min.	Date installed	Mill F		Mill S	
		No.	I.p.y.	No.	I.p.y.
50,000–55,000	1937–1942	3	0.010–0.014	7	0.022–0.062
50,000–55,000	1947–1952	12	0.023–0.042	2	0.032–0.059
70,000	1950	3	0.046–0.060	1	0.040

vidual digesters in 14 different mills is shown in Tables VI and VII. The distribution of the carbon steel corrosion rates does not show a homogeneous pattern and indicates that several different classes of behavior are involved. It may be seen that a large number of carbon steel digesters have negligible corrosion and would deserve further study as well as those with higher rates.

Table VIII shows detailed comparison within mills of old and new carbon steel and high tensile steel. The new data from ten digesters in mill S do not support the apparently clear-cut comparison in the first summary report, largely based on mill F. According to Table IX, the corrosion rates for digesters in mills H and C have decreased considerably but the relative performance of the modern rimmed types has not improved. From these two tables it is difficult to make any clear-cut statements as to relative corrosion resistance of carbon steels. However, it is strange that the specially prepared steels fail to show superior performance.

Table IX. Carbon Steel Corrosion Rates "Ordinary" and "Rimmed" Types

Type steel	Date installed	Mill C		Mill H	
		No.	I.p.y.	No.	I.p.y.
Ord.	1930	...	...	1	0.003
Ord.	1945–1951	3	0.044–0.049	1	0.007
Rim.	1951–1952	1	0.036	2	0.006–0.013
		6	0.049–0.058		
		1	0.077		

Corrosion rates of alloys are now available from 13 digesters and are compared in Table X. These results show an improvement in consistency due to additional data and by the use of medians yield a ranking for different alloys in the expected order of preference, although here again statistical variations exist. As previously mentioned, the Audigage measurements on alloys are more accurate and in addition, in several cases the measurements were independently checked by a magnetic gage. The alloy corrosion rates are definitely in the lower part of the range of the distribution for carbon steel.

The current corrosion rates have also been compared with historical rates for the same vessels up to the first inspection where an adequate time interval was available. These comparisons are summarized in Table XI

Table X. Alloy Alkaline Digesters

Alloy	Digesters	Mills	Corrosion, i.p.y. Median	Range
Inconel	6	C-F	0.004	0.000–0.018
316SS	2	F-S	0.006	0.000–0.012
347SS	4	M-Q-S	0.013	0.000–0.028
410SS	1	C	0.015	0.015

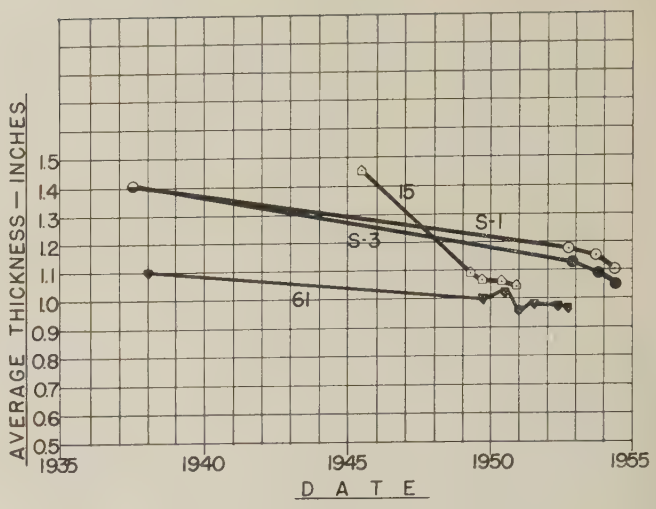

Fig. 5

and illustrated graphically for four selected vessels in Fig. 5. It is surprising that of the five mills investigated, only one shows a significant acceleration of corrosion. This does confirm, however, that digester corrosion is not a new problem, but rather one of which we have recently become aware.

The pronounced acceleration of corrosion in mill S was investigated in terms of possible influence by process variables. This comparison is made in Table XII. It is evident that a considerable part, but not all, of the corrosion increase is connected with increase in productivity of the individual digesters, actually reflecting an increase in the number of blows per day. The table suggests that the remaining increase may perhaps be connected with the general increase in sulphidity level.

Similar investigation was made for mills F and C for those digesters where available data on corrosion and process variables could be directly compared for the same time intervals. These comparisons are shown in Tables XIII and XIV. For these, the correlation with productivity was not obtained while for the process variables tabulated again only the sulphidity level seems to be correlated with corrosion. It may be noted also that the high corrosion in mill C during the period 1945 to 1949 occurred during a period of higher sulphidity, 23 to 25%. To summarize, in the only mill in which there was a significant general acceleration of corrosion, increased productivity is apparently an important factor. Of the other process variables, sulphidity is the only one for which available data indicate correlation with fluctuating corrosion within the same mills, but this variable fails to explain the difference in corrosion levels between mills. These comparisons, however, are fairly rough and it may be expected that if data were available for a more complete determination of the cooking liquor composition, a more meaningful comparison could be obtained.

Special comment is required in regard to the apparent

Table XI. Carbon Steel Alkaline Digesters Historical and Current Corrosion Rates

Mill	Date installed	Digesters	Corrosion, i.p.y. Historical	Current
C	1945	3	0.091–0.096	0.045–0.049
F	1937–1942	3	0.009–0.016	0.010–0.014
S	1937–1942	7	0.015–0.024	0.022–0.062
H	1929–1930	3	0.001–0.002	0.003–0.006
L	1929	1	0.014	0.010

Table XII. Digester Corrosion versus Process Variables
Mills S—Digesters S1-S7

Period	Corrosion, i.p.y.	Pulp/dig., tons/yr.	Sulphidity, %	Salt Cake, lb./ton	Sulphur, lb./ton
1937–1947	0.015–0.024	21,000	20–22	...	...
1948–1952		29,000	24–29	140–305	0–8
1953–1954	0.022–0.062	30,000	25–29	135–170	0

correlation of corrosion rates with the use of elemental sulphur in the data from mill F. This apparently contradicts the report by Hassler (*13*) as to the reduction of corrosion due to polysulphides produced when elemental sulphur is added to white kraft liquor. Actually, in mill F the sulphur was added in the green liquor; that is at a much earlier stage of the cooking liquor cycle. The same is true for mills S and C. The sulphur compounds produced in the digester by these two different methods of sulphur addition may be quite different. It is important to note that mills H and V, both having extremely low corrosion rates, use elemental sulphur in the white liquor. It seems clear that future study of these chemical reactions and their effect on corrosion would be desirable.

Table XIII. Digester Corrosion versus Process Variables
Mill F—Digesters 64–68

Period	Corrosion, i.p.y.	Cooking cycle, hr.	Sulphidity, %	Salt cake, lb./ton	Sulphur lb./ton
1947–1948	0.000–0.014	2:24	25	100	10
1949–1950	0.060–0.084	2:04–2:20	26–28	82–126	29–44
1951–1952	0.023–0.035	1:52–2:17	19–24	97–145	0

This completes the presentation of new and revised results from the digester corrosion survey. An overall interpretation of their meaning, together with those parts of the first summary report which have not been re-examined here, may be attempted once more. Although the survey is primarily quantitative in its approach, the elements of opinion and field observation have not been excluded. On the contrary, due to the existence of unpredictable variations in the data which have themselves been measured quantitatively, the possibility of verifying the numerical results with qualitative information has been deliberately sought. The results are undoubtedly a great step forward in our understanding of the problem, but a considerable area of uncertainty still remains. Thus a summary of conclusions may be offered, not as a superficial generalization as to cause and effect, but as a set of working hypotheses for immediate practical guidance, subject to further verification.

Table XIV. Digester Corrosion versus Process Variables
Mill C—Digester 14

Period	Corrosion rate I.p.y.	Corrosion rate in./M cooks	Sulphidity, %	Salt cake lb./ton	Sulphur, lb./ton
9/51–2/52	0.030	0.014	16–18	129	3.9
2/52–9/52	0.042	0.022	17–19	129	3.9

Table XV. Analysis of Localized Attack

Operating conditions	Number of digesters	Ratio of peak row-average corrosion rate to average rate for whole vessel: Median	Range
Forced circulation[a] with indirect heating:			
Upper part of digester	8	2.8	1.7– 6.3
Lower part of digester	8	1.8	1.5– 4.4
Natural circulation with direct heating:			
Upper part of digester	60	2.3	0.9–11.9
Lower part of digester	60	2.4	0.8–11.0

[a] Inlet at top and bottom, outlet at middle.

CONCLUSIONS

1. Available evidence does not indicate any general increase in the intensity of digester corrosion in recent years, although in one mill accelerated corrosion was found and correlated with higher production and sulphidity. Thus a new and more favorable historical perspective has resulted from the survey.

2. Short term fluctuations in corrosion within the same mills have been correlated with sulphidity variations, while the more favorable corrosion history of some mills as compared with others has been correlated with their use of elemental sulphur in white liquor as distinct from green liquor. More fundamental study of the effect of sulphur chemistry on corrosion is strongly recommended.

3. In most mills mild steel is a satisfactory material for alkaline digesters.

4. Although consistent differences in performance among different types and age groups of carbon steels within the same mills have not been clearly established, it does appear that both the high tensile carbon-silicon steels and the special modern rimmed digester steels tend to have inferior rather than superior corrosion resistance as compared with the more commonly used intermediate group characterized as ASTM A-285-C.

5. Generally superior corrosion performance has been found for alloy digesters, especially Inconel and type 316 stainless steel. These materials can probably be justified in mills having unusually severe corrosion conditions.

6. Accelerated localized corrosion in digesters seems to be prevalent and primarily correlated with the mechanical aspects of operation and design. This most urgent phase of the digester corrosion problem is especially amenable to control by the modern procedures of inspection and repair (*9*).

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Received Dec. 3, 1954. Presented at the Ninth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Philadelphia, Pa., Oct. 18–21, 1954.

Microbial Transformations and Effects of Dehydrated Ammonia-Base Sulphite Spent Liquor in Soils

W. B. BOLLEN

Effects of "Orzan A," a dehydrated spent ammonia-base suphite liquor, on different soils indicate that it has direct fertilizer values commensurate with its analysis and that in part these values may be enhanced by slow and thus prolonged availability. About 45% of the total nitrogen and 7% of the sulphur is readily available. With optimum moisture and temperature approximately one half of the nitrogen is readily nitrified, while the remainder is only very slowly liberated as ammonia and transformed to nitrates in soils. Under the same conditions sulphur of the lignin sulphonates is oxidized at rates comparable for flour sulphur. Increases in cell substance and carbon dioxide evolution resulting from rapid consumption of the sugars by various microorganisms can have indirect beneficial effects on soil fertility. The lignin complex is relatively resistant and can be expected to contribute extensively to formation of humus. The spent liquor solids had little effect on soil pH, and they caused no marked changes in numbers or kinds of microorganisms as determined by plate counts after 30 days incubation.

Orzan A* as an ammonia-base sulphite spent liquor in dehydrated form has a composition that suggests possible use as a soil conditioner and fertilizer. The principal components are lignin ammonium sulphonates and sugars, each of which may directly or indirectly cause soil aggregation. The nitrogen and sulphur analyses, although relatively low in comparison with commercial fertilizers, show that these essential and often deficient plant food elements are present in immediately as well as in potentially available forms. The sulphonic sulphur and that portion of the nitrogen not alkali replaceable should be rendered available sooner or later by decomposition of the organic constituents by soil microorganisms. While the C/N ratio of 15/1 appears favorable for such decomposition, the inherent resistance of lignin, by retarding its microbial alteration, could well lead to its persistence and desirable incorporation in the humus-complex.

The sugars, on the other hand, are readily available carbon sources present in considerable proportion, and with the amount of nitrogen apparently more than adequate for their microbial decomposition, should stimulate general microbial activity in the soil and thus indirectly benefit soil fertility. Examples of such indirect effects include: (1) solution of soil minerals effected by respiratory carbon dioxide, (2) fixation of nitrogen by such bacteria as *Clostridium butyricum*, (3) production of microbial slimes and gums as well as mold mycelia that could improve physical condition by increasing soil aggregation, and (4) increase in amount of dead bacterial proteins available for conjugation with resistant lignins to form the humus nucleus.

The acid character of Orzan A** is shown by the pH value of 2.8 for a 1:10 aqueous solution. At first glance, this would appear to limit its desirability for use on acid soils and enhance its value on highly alkaline soils. However, the equivalent acidity is slightly less than 500 p.p.m. (Table I) and 50 lb. of high grade limestone would neutralize 1 ton of Orzan A. It is unlikely, therefore, that applications within the range of feasibility would overcome the soil's buffer capacity and decrease the pH to any marked extent.

REVIEW OF LITERATURE

Previous studies on dolomite-base sulphite liquor in liquid form, containing 8% solids, have shown that as much as 80 tons per acre could be applied to growing plants in the greenhouse without injury and with some apparent benefit (*11*). When applied in irrigation water to field crops amounts up to 120 tons per acre had little effect on the soil but the heaviest treatment was somewhat depressive to growth of certain crops. The general conclusion from these greenhouse and field studies was that annual applications as high as 60 tons per acre were unlikely to injure either plants or soil and the possibility of desirable effects was not excluded (*12*). Moderate amounts of the liquor applied to soil were observed to increase general microbial activity, most of the constituents undergoing rapid transformation (*2*). About one half of the total sulphur content was rapidly available as sulphate; sulphite liquor can thus serve as a sulphur fertilizer, where the slow availability of the sulphonic combination could be advantageous. Other plant nutrients, including nitrogen, while available and of fertilizing value, are present in only minor concentrations in calcium and dolomite-base sulphite spent liquors. Sulphite lignins, although resistant like all lignins, appeared more readily decomposable than many others. Soil reaction was not greatly altered, even by heaviest treatments with the liquor; the pH was slightly lowered at first but gradually returned to essentially the original value.

Compared to sulphite spent liquors in liquid form Orzan A has the same evident advantage of other similar dehydrated products. It is a dry solid which can be readily handled and transported, so its use is not limited to areas in the vicinity of pulp and paper mills. Moreover, because it is derived from an ammonia-base liquor its nitrogen content is relatively high, and the product deserves consideration for fertilizing value.

To determine what action occurs on the major constituents of Orzan A when it is added to soil, and to find

W. B. Bollen, Bacteriologist, Oregon Agricultural Experiment Station, Corvallis, Ore.

* A product of the Crown Zellerbach Corp., who supplied this material and gave financial aid for conducting the investigation.

** The pH of Orzan A presently being marketed is about 4.0.

Table I. Chemical Analysis of Orzan A

	Parts per hundred
Moisture	5.12
Analysis of dry matter:	
Ash	1.02
Total Carbon[a]	51.55
Kjeldahl nitrogen	3.42
Ammonia nitrogen[b]	1.55
Alkali liberated NH_3[c]	3.45
Total sulphur[d]	6.43
Water soluble SO_4^{--}, as S	0.46
Lignin sulphonic acids[e]	51.0
Reducing substances, as glucose[e]	24.8
pH of 1:10 aq. solution	2.8
Titratable acidity to pH 7:	
Grams NaOH/100 g.	1.9
Equivalent p.p.m.[c]	475

[a] By dry combustion.
[b] By distillation from phosphate buffer solution at pH 7.4.
[c] Milliequivalents/1000 g.
[d] By fusion with $MgNO_3$.
[e] Data from Technical Bulletin 9-3, Crown Zellerbach Corp., Central Research Department, Camas, Wash.

what effects it may have on microorganisms related to soil fertility, a series of laboratory experiments were made with a number of widely different soil types. The investigation included studies on general microbial activities in soil as shown by plate counts and carbon dioxide evolution, and experiments on ammonification, nitrification, and sulphur oxidation as specific transformations.

EXPERIMENTAL

Soils used in the investigation represented 15 different soil types, ranging from sandy loam to clay adobe in texture and from acid to strongly alkaline in reaction. In organic matter they ranged from less than 1% for Newberg sandy loam to more than 50% in Klamath peat. With few exceptions the soil types are listed according to official soil survey classification; soils from areas not surveyed were texturally classified by subjective tests and were named according to the locality from which obtained. The soils and their properties pertinent to the various experiments are listed in Table VII.

Methods

Preparation of Sample. Ten-pound samples of Orzan A were taken from the center of each of two 100-lb. sacks, mixed and reduced to 5 lb. with a hand sample splitter. This subsample was passed through a 20-mesh screen, mixed, and stored in a tightly closed screw cap bottle for use as required in the laboratory. A 100-mesh analytical sample was prepared from the 20-mesh material.

Each soil sample was a composite of approximately 50 lb. taken to a depth of 6 in. from representative areas in the field. Any surface debris was first removed. Each sample was passed through a 10-mesh screen in the laboratory, mixed, and stored in tightly covered enamel-lined cans. Most of the samples were only slightly moist, but some of the heavier soils required partial air drying before they could be screened.

Analytical Methods

Moisture was determined as loss in weight by drying samples at 105°C. for 24 hr.

Saturation capacity of soils was calculated from the amount of water retained by samples in Gooch crucibles wetted from below by immersion, and then allowed to drain to constant weight in a moisture-saturated atmosphere.

Ash was determined by ignition at 900°C; total carbon, by dry combustion at 950°C.; total nitrogen, by the standard Kjeldahl method. Total sulphur was gravimetrically determined as $BaSO_4$ precipitated from a solution obtained following magnesium nitrate fusion (*12*). Water-soluble sulphate in Orzan A was similarly determined on a 1:5 aqueous solution of the sample. Sulphate in soils was estimated on 1:5 water extract; powdered barium chloride was added to solutions clarified as described under nitrification, diluted if necessary, and slightly acidified with hydrochloric acid; the resulting turbidity was read on a Bausch & Lomb monochromatic colorimeter, using a 630 mmu filter, and evaluated from a standard curve. Ammonia nitrogen was determined by distilling samples in phosphate buffer solution at pH 7.4 (*10*) and titrating the distillate with $N/14$ H_2SO_4, using methyl red-bromocresol green mixed indicator. This method includes ammonium in free and exchangeable forms, each of which are available for nitrification. pH determinations were made with a glass electrode electrometer; for mineral soils, readings were made on 1:5 distilled water suspensions from which coarse particles were allowed to settle; a 1:20 suspension was used for the peat soil.

Numbers of microorganisms were estimated by plating procedures. Peptone glucose acid agar was used for molds and sodium albuminate agar was employed for bacteria and *Streptomyces* (*6*).

Respiration studies were conducted with the general apparatus and procedure previously described (*1*). Two hundred grams of soil, water-free basis, were used for each treatment; incubation was at 28°C. with moisture content maintained at 60% of the saturation capacity. The evolved carbon dioxide was absorbed in approximately 1 *N* NaOH. Periodic determinations of the amounts evolved during a 30-day incubation period were made by double titration, using a Beckman automatic titrator. The results provide an index of the rate and extent of decomposition of Orzan A in comparison with other sources of organic matter.

Comparative ammonification and nitrification of Orzan A and peptone was studied by adding these materials at several different rates to 100-gram portions of soil and determining ammonia, nitrite, and nitrate nitrogen after 10 and 20 days' incubation in pint milk bottles. At these intervals replicate bottles of control and treated soils were removed for analysis. Samples equivalent to 10 grams, water-free basis, were removed for ammonia determinations by distillation from phosphate buffer solution as mentioned above. To the remaining soil, 90 grams water-free basis, distilled water was added to give 1:5 dilutions and the suspensions were shaken 30 min. Clear filtrates were obtained with the aid of copper hydroxide, substituting cupric acetate for copper sulphate in Harper's procedure (*8*), thus allowing sulphate determinations to be made on the same solution. Nitrites and nitrates were determined colorimetrically, using the alpha naphthylamine-sulphanilic acid method and the phenoldisulphonic acid method, respectively (*13*).

Oxidation of sulphur was studied by incubating 100-gram portions of soil with added flour sulphur and with

Table II. Effect of Orzan A on Microbial Numbers in Soil

Soil type	Moisture, %	Saturation capacity, %	pH	Molds: Total, thousands	Molds: Mucors, %	Molds: Penicilli, %	Molds: Aspergilli, %	Molds: Demitaceae, %	Molds: Trichoderma, %	Bacteria: Total, millions	Bacteria: Streptomyces, %
Vale sandy loam											
Original sample	16.3	65.8	8.8	1040	1	96	1	1	0	15.0	1
Incubated,[a] control	39.5	..	8.8	39	1	89	2	0	2	24.5	20
Incubated,[a] + Orzan A	39.5	..	8.4	29	1	87	8	0	2	37.0	16
Gooch fine sandy loam											
Original sample	21.3	66.0	10.1	1	42	47	1	0	0	1.0	0
Incubated, control	39.6	..	8.6	11	5	95	0	0	0	1.3	0
Incubated, + Orzan A[c]	39.6	..	8.1	22	5	91	0	0	0	3.2	0
Chehalis silty clay loam											
Original sample	8.2	62.9	5.9	67	3	29	26	0	0	31.7	30
Incubated, control	37.7	..	6.0	29	10	85	3	0	2	20.5	41
Incubated, + Orzan A[b]	37.7	..	5.6	38	3	71	25	0	1	32.5	46
Willamette silty clay loam											
Original sample	8.2	57.2	5.5	137	7	39	2	0	4	46.7	23
Incubated, control	34.3	..	5.4	215	18	79	2	0	1	62.0	40
Incubated, + Orzan A[b]	34.3	..	5.2	140	14	82	2	0	1	49.0	50

[a] 30 days at 28°C. with moisture at 60% saturation capacity.
[b] Orzan A equivalent to 1000 p.p.m. C, or 4080 lb. per acre.
[c] Orzan A at 5 tons per acre.

Orzan A for 10 and 20 days and then determining sulphates turbidimetrically on 1:5 extracts prepared and clarified as described under nitrification. The colorimetric and turbidimetric determinations were made with a Bausch & Lomb monochromatic colorimeter, using appropriate filters and standard curves.

Incubation temperature in all cases was 28°C. (82°F.). Where aeration was not forced as in the respiration experiment the bottles of soil were covered with uniformly punctured caps to permit gaseous exchange. Moisture loss was restored by weight at frequent intervals to maintain water content at near 60% of the saturation capacity, an amount considered optimum for general microbial activity in the soil. In a few cases longer incubation periods were used; these are indicated in the tables.

All data, except for pH, are expressed on the water-free basis. Rates of treatment given in parts per million (p.p.m.) also are on the water-free basis while tons per acre include moisture. Orzan A was used at several different rates as indicated in the tables; equivalents in the various elements concerned are also indicated. All treatments and determinations were made in duplicate.

RESULTS AND DISCUSSION

As shown in Table II, no outstanding increases or decreases in any of the several groups of microorganisms enumerated at 30 days, the time selected to represent an approximate equilibrium level, resulted from the Orzan A treatment. Since the original soil samples were low in moisture, the incubated controls showed higher numbers in most cases. *Streptomyces*, a genus of higher bacteria which are strongly oxidative but develop slowly, are of interest because of their ability to attack lignins. Where Orzan A was added their per-

Table III. Soil Respiration and Decomposition of Orzan A, Dextrose, and Sawdust as Indicated by Carbon Dioxide Evolution in 30 Days

Soil class and type	Sandy loam: Newberg	Sandy loam: Vale	Sandy loam: Vale[a]	Fine sandy loam: Gooch[a]	Fine sandy loam: Yakima	Fine sandy loam: Yakima[a]	Silty clay loam: Chehalis	Silty clay loam: Dayton	Silty clay loam: Willamette	Clay loam: Burns	Clay loam: Cascade	Clay loam: Ontario	Clay adobe: Medford	Peat: Klamath
pH	5.9	8.8	10.5	10.1	7.3	9.5	5.9	5.3	5.5	7.8	6.2	7.8	7.6	8.1
Carbon as HCO_3^-, p.p.m.	...	...	...	13	20	290	...	...	...	...	...	...	80	328
Carbon as CO_3^-, p.p.m.	...	...	...	70	0	560	...	...	...	...	...	...	0	0
Respiration capacity: Carbon evolved as CO_2 in 30 days, p.p.m.	153	388	149	215	325	151	301	275	148	1387	551	613	418	1204
Decomposition of additions in 30 days as shown by CO_2 evolution:														
(1) At 1000 p.p.m. C														
Dextrose, %	...	68	36	85	74	96	68	...	64	48	47	73	...	71
Orzan A, %	16[d]	11	7	35	16	18	16	3[d]	12	20	13	18	...	24
Ponderosa pine sawdust, %	...	...	7	11	22	12	3	...	4	1	...	9	...	15
(2) At 2000 p.p.m. C														
Dextrose, %	...	...	...	...	73	73	...	...	...	...	...	56	60	68
Orzan A, %	...	...	...	...	22	28	...	...	...	...	...	20	23	25
Douglas-fir sawdust, %	...	...	12[d]	...	4	17	...	10[d]	...	...	...	6	8	10
Ponderosa pine sawdust, %	...	...	...	...	10	13	...	...	...	...	...	8	16	13
(3) Sawdust at 2000 p.p.m. C with C/N adjusted 20/1.														
(a) with NH_4NO_3														
Douglas-fir, %	...	...	...	...	5	10	...	...	...	...	...	10	10	6
Ponderosa pine, %	...	...	...	...	5	6	...	...	...	...	...	17	8	5
(b) with Orzan A[b] + NH_4NO_3														
Douglas-fir,[c] %	...	...	13[e]	...	6	9	...	13[e]	...	...	...	3	1	7
Ponderosa pine,[c] %	...	...	...	...	9	10	...	...	...	...	...	10	9	8

[a] Alkali soil.
[b] Sawdust at 1790 p.p.m. C + Orzan A at 210 p.p.m. C, equivalent to 14 p.p.m. N.
[c] Corrected for calculated amount of CO_2 from Orzan A as given by Orzan A alone.
[d] Sawdust and Orzan A each at 1 ton per acre, equivalent to approximately 500 p.p.m. carbon.
[e] Orzan A + sawdust each at 1 ton per acre.

centage increased in the two acid soils but decreased in the moderately alkaline soil, although in the latter case their numbers increased above those in the control.

Because the *Streptomyces* and certain nonsporeforming bacteria largely responsible for lignin decomposition in the soil are relatively sensitive to acidity there may be some concern that by lowering pH Orzan A would inhibit these organisms. Only with the highly alkaline Gooch soil, however, was the pH of Orzan A treated soil less than in corresponding controls by more than 0.5. Usually the depression was only 0.2 to 0.3 pH, and similar reductions were produced by dextrose and by sawdust. Moreover, plate counts (Table II), where not showing increases, showed no marked reduction in bacterial numbers or *Streptomyces* percentage in Orzan A treated soils. For liquid dolomite-base sulphite spent liquor also it has been found that the acidity did not retard decomposition and that the effect on soil pH was negligible (*2*).

Both molds and bacteria increased in the strongly alkaline soil, probably due to the decrease in pH. This decrease is largely attributable to carbon dioxide production, and the greater decreases obtained with Orzan A are consistent with its high content of sugars which readily yield carbon dioxide on decomposition. The chemical analysis (Table I) shows that on an equivalent basis the readily oxidizable carbon in reducing substances is nearly five times the oxidizable sulphur. Despite the relative weakness of carbon dioxide as an acid, whatever effect Orzan A has on soil reaction may be ascribed more to the sugars than to the oxidizable sulphur compounds it contains.

As with the addition of any type of more or less readily decomposable organic matter to the soil, brief pronounced increases in molds and some bacteria could be expected within the first few days following Orzan A treatment. These changes were not determined by the laborious plating procedure but were incidently indicated by carbon dioxide evolution curves plotted from the respiration studies.

The rate and extent of carbon dioxide evolution from soils is a measure of decomposition for native as well as for added organic matter. In the latter instance it is assumed that all carbon dioxide above the amount released by the untreated soil control originates from the organic addition. This is probably true where the organic matter additions are not excessive. Increased microbial activity engendered by addition of 1% or more of carbonaceous material may accelerate decomposition of the native organic matter (*5*) but the effect is of minor practical importance (*9*). Nevertheless, soil respiration studies are important as an index of soil fertility and for indicating the relative decomposability of different organic materials (*1*). The data in Table II thus show that in the wide variety of soils, to to which all additions were on an equivalent carbon basis, Orzan A as a whole decomposed less rapidly than dextrose but more rapidly than sawdust. An exception occurred in Yakima fine sandy loam, where more carbon dioxide was produced from pine sawdust than from the

Table IV. Oxidation of Orzan A Sulphur Applied at 300 P.p.m.,[a] Compared with Flour Sulphur at 2000 P.p.m.

Soil and treatment	pH, Days 0	pH, Days 10	pH, Days 20	S as SO_4, p.p.m, Days 0	S as SO_4, p.p.m, Days 10	S as SO_4, p.p.m, Days 20	S oxidized, %, Days 10	S oxidized, %, Days 20
Vale sandy loam								
Soil only	8.8	8.7	8.8	65	70	74		
Orzan A	..	8.5	8.4	..	100	105	2	3
Sulphur	..	7.9	7.7	..	210	640	7	28
Vale sandy loam								
Soil only	10.5	10.7	10.5	1750	1720	1750	..	..
Orzan A	..	10.7	10.3	..	1950	2150	59	92
Sulphur	..	10.3	9.8	..	2100	2600	19	43
Yakima fine sandy loam								
Soil only	7.3	7.2	7.2	15	5	0	..	..
Orzan A	..	6.7	6.1	..	83	85	18	21
Sulphur	..	4.9	4.5	..	170	990	8	50
Yakima fine sandy loam								
Soil only	9.5	9.5	9.5	42	120	100	..	..
Orzan A	..	9.4	9.4	..	180	150	12	9
Sulphur	..	9.4	9.1	..	420	870	15	39
Chehalis silty clay loam								
Soil only	5.9	6.0	6.0	6	9	17	..	..
Orzan A	..	5.7	5.5	..	14	80	0	13
Sulphur	..	4.8	4.5	..	68	95	3	4
Willamette silty clay loam								
Soil only	5.5	5.5	5.4	8	10	12	..	..
Orzan A	..	5.3	5.2	..	16	20	0	0
Sulphur	..	4.7	4.3	..	74	162	3	8
Burns clay loam								
Soil only	7.8	7.8	8.0	225	190	120	..	..
Orzan A	..	8.0	7.8	..	180	160	0	6
Sulphur	..	7.8	7.4	..	1530	2220	67	100
Burns clay loam								
Soil only	10.2	10.3	10.2	2275	2300	2350	..	..
Orzan A	..	9.3	9.5	..	2300	2250	0	0
Sulphur	..	9.2	9.2	..	4150	4370	93	100
Cascade clay loam								
Soil only	5.9	5.7	5.6	1	3	2	..	..
Orzan A	..	5.9	5.7	..	11	8	0	0
Sulphur	..	5.4	5.2	..	48	187	2	9
Ontario clay loam								
Soil only	8.2	7.9	8.1	30	48	40	..	..
Orzan A	..	7.9	7.9	..	170	130	33	22
Sulphur	..	6.5	6.4	..	1060	1125	50	54

[a] Orzan A added at 5.3 tons per acre, equivalent, on water-free basis, to 300 p.p.m. S as ammonium lignin sulphonates plus 23 p.p.m. S as sulphate.

Orzan A. Since nearly 20% of the carbon in Orzan A is present in more readily decomposable reducing substances, equivalent to 24.8% calculated as glucose, and assuming the rest of the carbon to be in the lignin, a carbon dioxide production equivalent to more than 20% of the total carbon indicates theoretically that the excess was derived from decomposition of lignin. On this basis, with Orzan A equivalent to 1000 p.p.m. carbon the added lignins were appreciably decomposed only in the Gooch and Klamath soils. Percentage decomposition was greater when the rate of Orzan A treatment was doubled, so that lignin decomposition in these cases is indicated in the Medford and two Yakima soils as well as in the peat soil. In all these instances the extent of lignin decomposition was small: the increases of 2 to 15 over 20% could indicate oxidation of only 1 to 7.5% of lignin carbon. With dextrose applied at a doubled rate more carbon dioxide was evolved from the dextrose but the percentage decomposition was less.

Previous studies on dolomite-base sulphite liquor containing 8.28% solids showed that with a rate of 10 tons of liquor per acre, equivalent to 374 p.p.m. carbon of which 311 were in lignin, the lignin decomposition in Willamette silty clay loam soil amounted to 30% in 30 days and was complete in 300 days (*2*). The greater resistance of Orzan A lignins, especially as shown in the Willamette soil, may be a result of the dehydration process or of ammoniation. Although ammoniation would be expected to increase decomposability by providing nitrogen for microbial assimilation, the ammonia nitrogen combined with lignin sulphonate in Orzan A appears almost wholly unavailable in 30 days (Table VI).

With the alkali soils undetermined amounts of carbon dioxide could have been derived from carbonates. However, since bicarbonates are not decomposed above pH 5 and all Orzan A treated soils showed pH values above this, it is unlikely that appreciable amounts of carbon dioxide were liberated from mineral combination. It is more probable that with the Gooch and Yakima alkali soils, the original samples of which respectively contained 13 and 70, and 290 and 560 p.p.m., bicarbonate and carbonate carbon, that the respiration values were low because of absorption of carbon dioxide by the normal carbonate (*4*). This effect was small in the Yakima alkali soil but was extensive in the Gooch soil, where the pH of the incubated control fell from 10.1 to 8.6 in 35 days. Orzan A treatment, producing more carbon dioxide, lowered the pH still more. Orzan A lignin could therefore have been more extensively decomposed in the Gooch soil than is apparent from the carbon dioxide evolved. The other soils contained no normal carbonate.

Although not presented, graphs representing carbon dioxide evolution on a cumulative basis show forms characteristic of the relative resistance of the different organic materials. The curves for dextrose rise sharply and soon approach a slowly rising plateau indicating rapid attainment of an equilibrium level; for sawdust they rise briefly and level off more and more slowly; Orzan A curves are intermediate. With different soils the graphs vary in spread between the curves but not in their relative positions. Respiration capacity does not correlate with rate and extent of decomposition of added organic matter; within soils of the same textural class it is more indicative of the amount and extent of de-

Table V. Oxidation of Orzan A Sulphur and Flour Sulphur Applied at 1000 P.p.m.[a] in Oregon Soils

Soil and treatment	*pH* — *Days*			*S as* SO_4^{--} *p.p.m.* — *Days*			*S oxidized, %* — *Days*	
	0	*10*	*20*	*0*	*10*	*20*	*10*	*20*
Newberg sandy loam								
Soil only	5.9	5.4	5.6	17	17	12	..	..
Orzan A	..	5.8	5.7	..	200	185	11	10
Sulphur	..	5.2	5.0	..	190	240	17	23
Yakima fine sandy loam								
Soil only	7.4	7.4	7.1	14	30	10	..	..
Orzan A	..	6.9	6.6	..	155	90	5	0
Sulphur	..	5.2	5.4	..	115	285	9	28
Yakima fine sandy loam								
Soil only	9.8	9.9	10.0	40	65	80	..	..
Orzan A	..	9.8	9.6	..	55	180	0	2
Sulphur	..	9.7	9.8	..	330	400	27	32
Dayton silty clay loam								
Soil only	5.5	5.1	5.4	10	10	14	..	..
Orzan A	..	5.4	5.3	..	110	50	2	0
Sulphur	..	5.2	4.7	..	175	240	17	23
Ontario clay loam								
Soil only	8.2	8.1	7.5	17	30	25	..	..
Orzan A	..	6.2	6.3	..	50	35	0	0
Sulphur	..	5.7	5.8	..	42	500	1	48
Medford clay adobe								
Soil only	7.1	6.7	7.2	20	48	26	..	..
Orzan A	..	6.2	6.3	..	200	135	8	3
Sulphur	..	5.7	5.8	..	345	330	30	30
Klamath peat								
Soil only	8.1	7.7	7.9	1850	2300	2450	..	..
Orzan A	..	7.6	7.8	..	2750	3000	37	47
Sulphur	..	7.6	7.9	..	2500	3000	20	55
	Days			*Days*			*Days*	
	0	*35*	*100*	*0*	*35*	*100*	*35*	*100*
Gooch fine sandy loam								
Soil only	10.1	8.6	8.6	32	30	34	..	..
Orzan A[b]	..	7.5	7.1	..	195	750	1	28
Sulphur[b]	..	7.0	7.0	..	530	750	25	36

[a] Orzan A added at 17.6 tons per acre, equivalent, on water-free basis, to 1000 p.p.m. S as ammonium lignin sulphonates plus 77 p.p.m. S as sulphate.
[b] To the Gooch soil Orzan A was applied at 34.2 tons per acre and flour sulphur was applied at 2000 p.p.m.

composition of the native organic matter or humus. The Burns clay loam soil which showed the highest respiration is high in organic matter and much of this is incompletely stabilized. Organic matter constitutes over 50% of the Klamath peat but this is extensively decomposed, and the respiration capacity of this soil, while high, is less than for the Burns soil. Because of the more resistant nature of its organic matter, a more extensive lignin-decomposing flora could be expected in the peat soil and this could offer an explanation for the evident decomposition of added Orzan A lignin in this case. The more extensive decomposition of this lignin in the Gooch soil, which has a relatively low respiration capacity, may be due to a greater population of the specific bacteria involved, many of which could not develop on the plating medium employed. On the other hand, the absence of *Streptomyces* on the plates would suggest a slower decomposition.

Sawdust decomposition as indicated by carbon dioxide evolution was considerably less than shown for Orzan A, except for an unusual increase with ponderosa pine at 1000 p.p.m. carbon in Yakima soil. Distribution of the 51% total carbon in sawdust among the major constituents is approximately 25% in celluloses, 16% in lignins, and 10% in extractives, including 2 to 5% water soluble, the latter being higher in pines than in Douglas-fir. The water-soluble constituents may be considered readily decomposable, the celluloses less so. Whether free or combined with lignin, celluloses are attacked more or less slowly in the soil by specific microorganisms. With Douglas-fir and ponderosa pine sawdust carbon dioxide evolution during 50 days decomposition in Chehalis silty clay loam soil could account for 60 and 70% mineralization of the holocellulose, assuming little or no lignin decomposition.* Since the lignins are most resistant it is apparent from Table IV that they contributed little if any to the carbon dioxide production in 30 days, even in those soils giving evidence of some Orzan A lignin decomposition. Although the data are limited they suggest that lignin in Orzan A is less resistant than lignins as they occur in woods. It should be useful in building up soil humus.

Where sources of additional nitrogen were added with the sawdust the carbon dioxide production in most cases was decreased or but slightly increased. This phenomenon is commonly exhibited in soil respiration experiments. From practical field experience it is known that decomposition of readily decomposable organic matter having a wide carbon:nitrogen ratio is favored by adding nitrogen to adjust this ratio to approximately 20:1 (*3*). Under optimum conditions in the laboratory, however, the added nitrogen stimulates a burst of mi-

* Unpublished data.

Table VI. Ammonification and Nitrification of Orzan A

Soil and treatment	Ammonia nitrogen, p.p.m. Days 0	10	20	Ammonification, % Days 10	20	Nitrate nitrogen, p.p.m. Days 0	10	20	Nitrification, % Days 10	20	pH Days 0	10	20
Newberg sandy loam													
Soil only	31	32	4	...	..	13	19	45	..	..	5.9	5 4	5.7
Orzan A at 50 p.p.m. N	..	117	17	100	[a]	...	17	52	0	30	..	5.6	5.4
Orzan A at 100 p.p.m. N	..	87	16	18	[a]	...	14	43	0	0	..	5.6	5.5
Yakima fine sandy loam													
Soil only	1	2	53	...	..	19	43	49	..	..	7.3	7.4	7.1
Orzan A at 570 p.p.m. N	..	207	258	0	0	...	11	13	0	0	..	6.9	6.6
Peptone at 570 p.p.m. N	..	123	101	21	[a]	...	20	33	0	0	..	7.1	6.9
$NH_4/_2SO_4$ at 1000 p.p.m. N	..	770	628	...	..	...	65	125	2	8	..	6.2	6.1
Yakima fine sandy loam													
Soil only (alkali)	0	0	0	...	..	20	24	20	..	..	9.5	9.9	10.0
Orzan A at 570 p.p.m. N	..	170	168	0	0	...	0	0	0	0	..	9.8	9.6
Peptone at 570 p.p.m. N	..	225	149	37	[a]	...	0	0	0	0	..	10.1	10.2
NH_4/SO_4 at 1000 p.p.m. N	..	624	575	...	..	...	18	9	0	0	..	9.2	9.3
Chehalis silty clay loam													
Soil only	10	10	18	...	..	12	23	29	..	..	5.9	6.0	6.0
Orzan A at 170 p.p.m. N	..	80	88	0	0	...	32	52	11	30	..	5.7	5.5
Dayton silty clay loam													
Soil only	26	2	12	...	..	18	25	57	..	..	5.5	5.1	5.4
Orzan A at 50 p.p.m. N	..	11	41	0	22	...	18	39	0	0	..	5.2	5.4
Orzan A at 100 p.p.m. N	..	7	25	0	0	...	18	47	0	0	..	5.2	5.3
Ontario clay loam													
Soil only	7	60	63	...	..	40	48	50	..	..	8.2	8.1	7.6
Orzan A at 570 p.p.m. N	..	245	115	0	0	...	10	2	0	0	..	7.5	6.8
Peptone at 570 p.p.m. N	..	188	36	30[b]	57[b]	...	94	400	8	61	..	8.4	6.5
$NH_4/_2SO_4$ at 1000 p.p.m. N	..	685	455	...	..	...	45	300	0	25	..	7.1	5.8
Medford clay adobe													
Soil only	5	5	0	...	..	9	14	35	..	..	7.1	6.7	7.2
Orzan A at 570 p.p.m. N	..	130	145	0	0	...	15	73	0	15	..	6.2	6.3
Peptone at 570 p.p.m. N	..	128	95	31[b]	49[b]	...	70	218	10	32	..	6.8	6.5
$NH_4/2SO_4$ at 1000 p.p.m. N	..	625	565	...	..	..	18	140	0	11	..	6.0	6.1
Klamath peat													
Soil only	17	15	10	...	..	410	470	700	..	..	8.1	7.7	7.9
Orzan A at 570 p.p.m. N	..	28	40	0	0	...	400	740	0	15	..	7.6	7.8
Peptone at 570 p.p.m. N	..	50	20	18[b]	31[b]	...	540	870	12	30	..	8.0	7.6
$NH_4/_2SO_4$ at 1000 p.p.m. N	..	375	23	...	..	...	530	970	6	27	..	7.6	7.7
		days 35	100	days 35	100		days 35	100	days 35	100		days 35	100
Gooch fine sandy loam													
Soil only	0	0	0	...	..	3	4	30	..	..	10.1	8.6	8.5
Orzan A at 1000 p.p.m. N	..	80	40	0	0	...	154	260	33	51	..	7.5	7.6
Peptone at 1000 p.p.m. N	..	510	...	53[b]	..	...	24	...	2	..	..	7.7	..
$NH_4/2SO_4$ at 1000 p.p.m. N	..	200	30	...	..	...	200	375	20	35	..	7.4	7.4

[a] Ammonia nitrogen distilled at pH 7.4 decreased with no compensation in nitrates.
[b] Including nitrate produced from ammonia liberated in ammonification.

Table VII. Soil Characteristics and Transformations of Orzan A

Summary table

Soil class and type	pH	Saturation capacity, %	Nitrogen, p.p.m. NH_4^+	Nitrogen, p.p.m. NO_3^-	Sulphur, p.p.m. SO_4^{--}	Ammonification N no.	Ammonification 10 days, %	Ammonification 20 days, %	Nitrification, % 10 days	Nitrification, % 20 days	Sulphur oxidation S no.	Sulphur oxidation 10 days, %	Sulphur oxidation 20 days, %	Decomposition of Orzan A [e] at 2.1 T/acre [f]	Decomposition of Orzan A [e] at 4.2 T/acre
Sandy loam															
Newberg	6.0	57.1	31	13	17	(1)	18	[b]	0	0	(2)	11	10	16[d]	..
	..	..	..	...	..	(2)	100	[b]	0	30	..	..	...	..	..
Vale[a]	8.8	65.8	0	2	65	(3)	...	..	0	1	(1)	2	6	11	..
Vale (alkali)[a]	10.5	60.1	0	0	1750	(3)	..	..	4	5	(1)	59	92	7	..
Fine sandy loam															
Gooch	10.1	66.0	0	3	32	(5)	0	0	33[c]	51[c]	(3)	1	28	35	22
Yakima	7.3	30.6	1	19	15	(4)	0	0	0	0	(2)	5	0	16	28
	..	..	..	..	..	(3)	..	..	24	44	(1)	18	21	..	..
Yakima (alkali)	9.5	35.7	0	20	155	(4)	0	0	0	0	(2)	0	2	18	..
	..	..	..	..	..	..	..	..	..	..	(1)	12	9	..	..
Silty clay loam															
Chehalis	5.9	62.9	10	12	6	(3)	0	0	11	30	(1)	0	13	16	..
Dayton	5.3	69.7	26	18	10	(2)	0	22	0	0	(2)	2	0	3[d]	..
Willamette	5.5	57.2	0	14	8	(3)	..	..	0	0	(1)	0	0	12	..
Clay loam															
Burns[a]	7.8	128.0	3	55	225	(3)	..	..	3	5	(1)	0	6	20	..
Burns (alkali)[a]	10.2	94.1	0	0	2275	(3)	..	..	0	4	(1)	0	0	0	..
Cascade	5.9	49.5	20	6	1	(3)	..	..	0	6	(1)	0	0	13	..
Ontario[a]	8.2	49.1	7	40	30	(4)	0	0	0	0	(2)	0	0	18	20
	..	..	..	..	..	(3)	..	..	4	14	(1)	33	22	..	..
Clay adobe															
Medford	7.1	77.6	5	9	16	(4)	0	0	0	15	(2)	8	3	..	23
Peat															
Klamath	8.2	225.3	17	410	1850	(4)	0	0	0	15	(2)	37	47	24	25
	..	..	..	..	..	(3)	..	..	12	28	..	..	..	..	..

[a] Not classified by official soil survey.
[b] Ammonia nitrogen distilled at pH 7.4 decreased with no compensation in nitrate.
[c] At 35 days and 100 days.
[d] Orzan A at 1 ton per acre.
[e] Per cent of total carbon oxidized to CO_2 in 30 days; percentage above 20 indicates lignin decomposition.
[f] Equivalent to 1000 p.p.m. carbon.
N no. = Nitrogen potentially available in Orzan A additions:
(1) 55 p.p.m. ammonifiable + 45 p.p.m. as nitrifiable.
(2) 27 p.p.m. ammonifiable + 23 p.p.m. as nitrifiable.
(3) 93 p p.m. ammonifiable + 78 p.p.m. as nitrifiable.
(4) 310 p.p.m. ammonifiable + 260 p.p.m. as nitrifiable.
(5) 547 p.p.m. ammonifiable + 453 p.p.m. as nitrifiable.
S no. = Sulphur potentially available in Orzan A additions:
(1) 300 p.p.m. exclusive of 23 p.p.m. S as SO_4^{--}
(2) 1000 p.p.m. exclusive of 77 p.p.m. S as SO_4^{--}
(3) 2000 p.p.m. exclusive of 154 p.p.m. S as SO_4^{--}

crobial activity that is not long maintained. As a result the carbon dioxide production may soon fall below that from materials limited in nitrogen. In effect the initial more rapid decomposition ties up the available nitrogen as well as some carbon in resistant bacterial protein, after which decomposition must proceed essentially the same as without added nitrogen and thus becomes dependent upon repartition of that which has been assimilated. This is usually well exhibited when sawdust and other plant residues high in resistant constituents are added to the soil.

Addition of Orzan A as a supplementary source of nitrogen gave results similar to those with ammonium nitrate alone. Because of its high sugar content Orzan A could not be used as the sole source of added nitrogen in adjusting the carbon : nitrogen ratio to 20 : 1.

A little more than one half of the nitrogen in Orzan A is not distillable as ammonia with approximately 1% phosphate buffer at pH 7.4. Since plants require nitrogen as ammonia or nitrate, which in soils are produced from ammonia, it is desirable to know if the firmly held nitrogen could be made available by soil microorganisms. The process of ammonification of organic nitrogenous compounds, usually proteins, involves digestion to amino acids and subsequent oxidation-reduction to carbon dioxide, water, and ammonia. A great variety of molds and bacteria, including *Streptomyces*, effect this transformation. A few highly specific bacteria oxidize ammonia to nitrite and others continue the oxidation to nitrate. To determine whether or not available nitrogen could be produced from the lignin ammonium sulphonates in Orzan A the ammonification and nitrification experiments set up as in Table VI were run as described under methods.

In all cases nitrates were derived almost entirely from the readily distillable ammonium nitrogen. Nitrification percentage is calculated on the basis of total nitrogen, and unless the percentage exceeds 45, as with the Gooch soil at 100 days, no nitrates could be considered derived from the ammonium more firmly held in the ligninsulphonates. Peptone and ammonium sulphate were used as the usual standards for comparison. Transformations of Orzan A are summarized in Table VIII, which includes several soils for which detailed experimental data are not presented.

Orzan A nitrogen, exclusive of ammonia distilled at 7.4, appears highly resistant to liberation by microorganisms. Only in the Dayton and Newberg soils, where Orzan A was used at low rates equivalent to 50 and 100 p.p.m. N, was any ammonification evident. Nitrification occurred in most of the soils and was extensive in some. More nitrates were produced over a longer time in the Gooch soil. Where nitrification was zero or very low, sulphur oxidation also was zero or low. The large amount of sugar in Orzan A probably caused these retarding effects; the microorganisms involved are almost exclusively autotrophic bacteria, and in general these are inhibited by relatively small amounts of water-soluble organic matter. With longer incubation periods the sugar would be decomposed and its interference thus eliminated.

Ammonification percentages as calculated are subject to error resulting from denitrification losses and from some absorption of ammonium by clay minerals of the soil. Marked decreases in ammonium concentration sometimes occur without a compensating increase in nitrates. The sum of ammonium, nitrite, and nitrate

nitrogen at the close of an incubation period often falls short of balancing the nitrifiable nitrogen present at the beginning. In the soils treated with ammonium sulphate the recovery of ammonium at 20 days was in many cases only 50 to 60% and the difference was usually not made up by nitrification. It is possible that some ammonia was lost by volatilization, but such losses should have been slight because evaporation was kept low. Assimilation of available nitrogen by microorganisms can account for only small amounts.

Nitrite concentrations in all cases were less than 1 p.p.m. and the data are omitted. Transformation of ammonia to nitrite in soils is normally less rapid than oxidation of nitrite to nitrate. In some cases ammonia will not completely nitrify at high alkalinity. Little or no nitrate accumulated in the alkali soils, except in the Gooch soil where the pH fell to 7.5 in 35 days.

Sulphur oxidation in soils is a function of certain autotrophic bacteria, usually limited to members of the genus *Thiobacillus*. Different species have different favorable pH ranges but one or more representatives of the group are likely to be active at any pH in soils ranging from strongly acid to highly alkaline. The transformations they effect produce sulphates as available plant food and permit the use of elemental sulphur or oxidizable sulphur compounds to overcome soil deficiencies. High acidity produced and tolerated by certain species also makes feasible the use of heavy applications of sulphur in the reclamation of alkali soils.

In the experiment reported in Table IV Orzan A equivalent to 300 p.p.m. sulphur, exclusive of sulphate, was found to give rise to sulphates rapidly in some soils, but slowly or not at all in others. These differences do not correlate with differences in pH or sulphates in the original soil. Flour sulphur, which was oxidized in all the soils, was least rapidly oxidized in the three acid soils, in two of which sulphates were not produced from Orzan A. Low sulphur oxidizing power of acid soils from the Willamette Valley has been noted previously (*7*). With exception of the Burns soils Orzan A sulphur was oxidized more rapidly in the soils having higher pH values. Elemental sulphur also was more rapidly oxidized in the alkaline soils. The extremely rapid transformation in each of the Burns soils, however, shows that pH is not the only important factor involved. Indigenous species and strains of *Thiobacillus* and their adaptations are probably as important as environmental factors.

It should be observed that approximately 7% of the total sulphur in Orzan A occurs as sulphate. This as well as the soil sulphate shown by controls must be subtracted from the total found in Orzan A treated soils at the close of incubation to calculate the sulphur oxidized.

In the second experiment Orzan A was applied on an equivalent basis, excluding sulphates, with flour sulphur at 1000 p.p.m. This has an apparent advantage over the ratio used in the first series of tests, but has the disadvantage of the high proportion of sugar introduced by Orzan A; as previously mentioned, autotrophic bacteria are more or less inhibited by appreciable concentrations of soluble organic matter. This influence was shown in the nitrification study, and is also evident generally in the results shown in Table V. In most cases sulphates were produced less rapidly with the heavier Orzan A application. Flour sulphur, on the other hand, was more rapidly oxidized at 2000 than at 1000 p.p.m. Over a longer time more Orzan A sulphur is transformed, as shown for 100 days with the Gooch soil. Orzan A equivalent to flour sulphur at 1000 p.p.m. closely approaches the latter in pH lowering effect but as previously pointed out much of this effect is probably due to carbon dioxide liberated in decomposition of the sugars.

CONCLUSIONS

1. Orzan A, a dehydrated ammonia-base sulphite spent liquor, applied to soils caused no marked changes in numbers of microorganisms as determined by plate counts at the close of 30 days' incubation.

2. Evolution of carbon dioxide from Orzan A treated soils was due chiefly to decomposition of sugars. The lignin complex was little decomposed in 30 days, although in several soils it proved less resistant than the lignin in pine or fir sawdust.

3. The ammonium nitrogen distillable at pH 7.4 is readily nitrified, although the sugars present may be temporarily inhibitive. The remainder, approximately one half of the total nitrogen in the lignin ammonium sulphonates, is only very slowly liberated as ammonia and transformed to nitrate in soils.

4. Sulphur of the lignin sulphonates is oxidized to sulphate in soils at rates generally comparable for flour sulphur.

5. Of the fertilizer elements in Orzan A about 45% of the total nitrogen and 7% of the sulphur is readily available. The sulphonic sulphur is oxidized to available sulphate more rapidly in some soils than others. These differences are probably due to influence of ecological factors on the sulphur oxidizing bacteria. With few exceptions the sulphonates, as well as flour sulphur, were oxidized more rapidly in the alkaline soils.

6. Microbial transformations and effects of Orzan A observed in different types of soils point to the conclusion that it has direct fertilizer values commensurate with its analysis, and that in part these values may be enhanced by slow and thus prolonged availability. Indirect benefits can result from the sugars as a source of energy for various microorganisms and from the carbon dioxide released. The lignin can be expected to extensively contribute to formation of humus.

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Received Oct. 4, 1954. Published as Technical Paper No. 875 with the approval of the Director of the Oregon Agricultural Experiment Station. Contribution of the Department of Bacteriology.

A Study of Light Scattering on Xylan

M. HORIO, R. IMAMURA, and H. INAGAKI

Light scattering and dissymmetry of scattered light of dioxane solutions of benzyl acetyl xylan prepared from beech xylan are measured. The molecular weight and the dimension of the molecule are computed from these optical data. The D.P. of benzyl acetyl xylan is 175 ± 10, and the root mean square distance between the ends of a molecule corresponds to the fully extended length computed from molecular weight.

Hemicelluloses are widely found in nature in lignified cell walls in company with the cellulose. In most of the chemical pulp processes a considerable fraction of the originally existing hemicelluloses in wood is removed during the cooking and refining stages. While the utilization of hemicelluloses is an important project of industry, the hemicelluloses remaining in resulting pulp are also significant for their end uses. Hemicelluloses have an eminent influence upon beating resistance and swelling of pulp and various mechanical properties and opacity of paper (*5*). On the other hand, they modify the character of dissolving pulp in variety of manners according to their amounts and kinds. The characteristic difference in polymeric and chemical properties between cotton cellulose and purified wood cellulose may greatly be attributed to the influence of a small amount of hemicelluloses contained in the latter.

Nowadays we have a very clear and well-established idea concerning the chemistry of the "true" cellulose and its construction from dimensions of atoms to macroscopic fiber as well as its solution state. As to the hemicellulose, in spite of the intense attention hitherto devoted to it, our knowledge on it is yet imperfect compared to that on cellulose. Of utmost interest is the polymeric properties of hemicelluloses. Along this line, since the exploiting work of Husemann (*7*), we have a series of further works which have recently been published by Millet and Stamm (*8*), Timell and Jahn (*11*), Wethern (*12*), and Thompson and Wise (*10*). In these papers viscosity and osmotic data are mainly utilized to clarify the polymeric properties of hemicellulose fractions in various wood and grasses. The underlying principle of the methods employed in these papers consists in determining the constant K_m in the usual viscosity formula by measuring the intrinsic viscosity $[\eta]$ and the molecular weight (number average) by the osmotic data for the same sample. Knowing the value of K_m the molecular weight (weight average) is computed from the viscosity data. The magnitude of K_m was used further to infer the shape of the molecules, although only in qualitative sense. The spreading data or diffusion coefficients were also used to estimate the axis ratio of the molecules.

A more recent technique for high polymer reasearches is the measurement of light scattering which is capable of providing more precise information for both the size and shape of high polymer molecules. This paper deals with the light scattering measurement of dioxane solutions of benzyl acetyl xylan derived polymer-analogously from xylan-rich hemicellulose fraction of beech wood.

M. Horio, Professor; R. Imamura, Lecturer; H. Inagaki, Assistant Professor; Kyoto University, Japan.

THEORY OF LIGHT SCATTERING

A brief description will be made here on the theory of light scattering as far as necessary for this paper. When a well-cleaned solution of a polymeric substance is illuminated by a parallel beam of light which is not absorbed by the medium, a small fraction of light is scattered and the intensity of transmitted light is decreased as shown by the following equation:

$$I = I_0 \exp(-\tau d) \qquad (1)$$

where I_0 is the intensity of the incident beam and I is that of the transmitted beam and d is the depth of the transmitted layer of the medium. τ is defined as the turbidity. The turbidity ($cm.^{-1}$) as defined above is approximately equal to the total energy of scattered light (ergs) per unit intensity of the incident light ($ergs \cdot cm.^{-2}$) and per unit volume of the solution ($cm.^3$). The scattering of light is due on one hand to the minute fluctuation of density of the solvent, and on the other hand, to the fluctuation of the concentration of the solute molecules. The object of discussion in our case is confined to the turbidity due to the latter which can be determined practically by subtracting the solvent turbidity from the total turbidity.

The originating work of Debye (*1*) on light scattering in solutions was immediately followed by Doty, Zimm, and Mark (*3*) who further developed the method into a more refined form available for molecular weight determination. According to them the molecular weight of solute molecules is correlated with the excessive turbidity by the following equation:

$$Hc/\tau = 1/M + 2A_2c \qquad (2)$$

where M is the molecular weight and c is the concentration of the solute molecules. H is given by

$$\frac{32\pi^3 n_0^2 (\partial n/\partial c)^2}{3N_0\lambda^4}$$

where λ = wave length of the light in vacuum, n_0 = refractive index of the solvent for that light, n = refractive index of the solution, and N_0 = Avogadro's number, $6.02 \cdot 10^{23}$. In general, n increases linearly with concentration for dilute solutions and therefore $\partial n/\partial c$ is constant for a certain solute-solvent system. H is determined experimentally by measuring the refractive index and its concentration gradient. The coefficient A_2 in equation (2) is that of the second power in the equation of osmotic pressure π represented as a power series:

$$\pi = RT[c/M + A_2c^2 + \ldots]$$

Equation (2) shows that the plotting of Hc/τ against c gives a straight line whose intercept on the Hc/τ axis gives the reciprocal of molecular weight of the solute molecules.

The relation of equation (2) is valid for scattering particles which are sufficiently small to be assumed as point sources. If, however, the linear dimension of the particles is a significant fraction of the wave length of the light ($>1/20$), interference will occur between the light waves scattered from different points within the same particle. At concentrations sufficiently low to eliminate the intermolecular interference the diminution of the intensity of the scattered light can be given for randomly coiled molecules by the expression:

$$P(\theta) = \frac{2}{x^2}\left[e^{-x} - (1 - x)\right]$$

$$x = \frac{8\pi^2}{3}\left(\frac{R}{\lambda'}\right)^2 \sin^2\frac{\theta}{2} \qquad (3)$$

where R = root mean square distance between the ends of the random coil, λ' = wavelength of the light in solution, and θ = scattering angle with reference to the forward direction of the incident beam.

The scattering factor (*4*) $P(\theta)$ given in equation (*3*) assumes a uniform molecular weight. However, polymers are usually polydispersed and have more or less broad molecular weight distributions which are frequently expressed by the exponential distribution, $f(M) = aM \exp(-bM)$, where M = molecular weight and a and b are constants. This expression approximates many other more complicated distributions. If $a = (2/\langle M\rangle)^2$ and $b = 2/\langle M\rangle$ where $\langle M\rangle$ = weight average molecular weight, $P(\theta)$ reduces to a particularly simpler form:

$$P(\theta) = (1 + <x>/2)^{-1} \qquad (4)$$

where $\langle x\rangle$ has the same meaning as x in equation (3) if the weight average value is used for R^2.

The particle scattering factor makes possible the evaluation of the dimensions of particles R by measuring the dissymmetry of the scattered light. The limit value of the dissymmetry coefficient $q = I(\theta_1)/I(\theta_2) - 1$ extrapolated to the zero concentration should be equal to $P(\theta_1)/P(\theta_2) - 1$, where $I(\theta_1)$ and $I(\theta_2)$ are the intensities of the scattered light at an angle respectively θ_1 and θ_2, θ_2 being equal to $180° - \theta_1$, with respect to the direction of the incident beam, and $P(\theta_1)$ and $P(\theta_2)$ are the particle scattering factors for the angle, respectively θ_1 and θ_2 and can be calculated by the use of equations (3) or (4) assuming various values of R/λ'. Equation (3) may be used for monodispersed systems and equation (4) for polydispersed ones. In practice it is fairly common to choose the angles 45° (θ_1) and 135° (θ_2). A large scale graphic reproduction of the calculation data of R/λ' against $P(\theta_1)/P(\theta_2) - 1$ enables us to find R/λ' as a function of q which, on the other hand, can be obtained by extrapolating the $1/q$ or q against c curve to the zero concentration. Further, the evaluation of the molecular dimension R makes possible the correction of the observed intensity at any angle for the loss due to intramolecular interference.

In the absence of intramolecular interference turbidity can be given by the expression:

$$\tau = \frac{8\pi}{3}\frac{i_0 r^2}{I_0 V} \qquad (5)$$

where i_0 = intensity of scattered light at zero angle, r = distance between solution and detector, I_0 = intensity of the incident light, V = illuminated volume.

In case the intramolecular interference is present the observed turbidity may be expressed as

$$\tau = \frac{i_0 \pi r^2}{I_0 V}\int_0^\pi P(\theta)(1 + \cos^2\theta)\sin\theta\, d\theta \qquad (6)$$

The ratio of equation (6) to equation (5) is named particle dissipation factor and denoted by Q, thus

$$Q = {}^3/_8 \int_0^\pi P(\theta)(1 + \cos^2\theta)\sin\theta\, d\theta$$

Doty and Steiner elaborated the tables which give the values of $1/Q$ as a function of R/λ' for spheres, monodispersed and polydispersed coils, and rods. For the molecule which can no longer be considered a point source equation (7) must be used instead of equation (2) for the determination of molecular weight.

$$H\frac{c}{\tau} = \frac{1}{MQ} + 2A_2 c \qquad (7)$$

MEASUREMENTS OF TURBIDITY AND DISSYMMETRY

Turbidity Measurements

The turbidimeter constructed for this work is schematically shown in Fig. 1. The light from a high pressure mercury lamp (110 v., 100 watts) LS is condensed by a lens L_1, and after passing through a slit S_1, is collimated by a lens L_2. This pencil of light is deflected at right angle by a prism P_1 and separated into component rays by a direct vision prism P_2. Lens and prism system L_3, L_4, P_3, and P_4 and a slit S_2 are adjusted so that the monochromatic light pencil having a wavelength 5461 A. passes through a rectangular cell C. The container box of the cell is partitioned into two sections B_1 and B_2. B_1 is circulated by water from a thermostat to keep the temperature of solution in the cell constant. Two holes perforated through the diaphragm permit the two beams of light scattered at 90° to be received by a Pulfrich photometer PP, by means of which the relative intensities of two beams are visually measured. The turbidity of the sample solution can be calculated by the equation:

$$\frac{I_2}{I_1} = e^{-\tau d} \qquad (8)$$

where I_1 is the intensity of scattered light received by the window nearer to the light source along the path of light, and I_2 is that received by the other window and d is the distance between the centers of two windows, which is 60 mm.

The turbidity of the usual polymer solution is too small to permit the precise determination of τ in this way, since I_1 and I_2 are very small and the ratio is nearly equal to unity. It is convenient to compare the intensity of scattered light from the polymer solution with that of light scattered from a standard opalescent medium. Water suspension of polystyrene latex was used as a standard, which has sufficiently great turbidity of the order of 10^{-2} cm.$^{-1}$, and the turbidity τ can be found by means of equation (8). The particles of the latex are spheres as could be recognized by an electron microscope.

After measuring the turbidity of the standard medium a small fraction of the beam is bypassed by a

prism system so as to be received by a window nearer to the light source. The intensity of the bypassed beam is standardized by obtaining a photometric match again. The reading of the graduated scales on the dial D_2 is R_s when the standard polystyrene latex

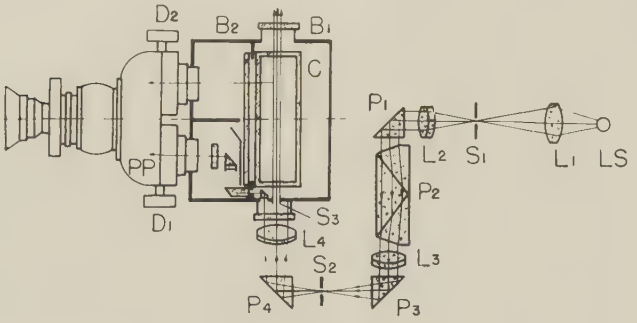

Fig. 1. Schematic representation of the turbidimeter

is illuminated. The scales indicate the slit area and, accordingly are inversely proportional to the light intensity. The latex suspension is then replaced by the polymer solution to be tested and the dial D_2 is adjusted until the two half-fields are equally bright. During the measurement the dial D_1 should be kept untouched. Let the reading of the scales on D_2 be R. Then the turbidity τ which may be applied to equation (7) is given by the following relation:

$$\frac{R_s}{R} = \frac{\tau P(90°)Q_s}{\tau_s P_s(90°)Q} \qquad (9)$$

where subscript s pertains to the values of the standard polystyrene latex.

Dissymmetry Measurements

The principle of the apparatus is similar to that used by Stein and Doty (*9*). The collimated monochromatic light pencil from the source passes through the center of the cell and out through the exit hole as in the case of turbidity measurements. Two first-surface mirrors M_1 and M_2 are placed in the room B_2 of the box so that the windows of the photometer can receive two symmetrically scattered beams of light reflected by the mirrors (see Fig. 2). By a screw device the two mirrors can be rotated symmetrically, and this permits variation of the mirror angles symmetrically about the 90° axis. The interior of the box is coated with dark lacquer to minimize the effect of stray rays.

The dissymmetry of the water suspension of polystyrene latex was measured at 45 and 135° which are the actual angles in solution. The angles in the air are found from a simple consideration of refractive index of the suspension. When dioxane is used as a solvent as is the case for benzyl acetyl xylan the angles 45 and 135° in solution result in too great divergency of the two scattered beams in the air, since the refractive index of dioxane is greater. So the measurements were carried out at 55 and 125°. The R/λ' versus q curves for these angles were prepared by using equations (3) and (4), respectively, for monodispersed and polydispersed system of randomly coiled molecules.

$\partial n/\partial c$ Measurements

A differential refractometer constructed according to Debye (*2*) was used to find the difference in refractive indices between solution and solvent at the wavelength mentioned above. The plots of $n - n_0$ against c represent a straight line from whose slope $\partial n/\partial c$ is found.

EXPERIMENTAL

Material

Benzyl acetyl xylan was prepared by subjecting the hemicellulose isolated from beech holocellulose to successive operations of benzylation and acetylation. The preparation of holocellulose was carried out according to Wise et al. (*13*) using beech meal as raw material. The holocellulose was suspended in an excessive amount of 8% caustic solution, preliminarily bubbled with hydrogen, and stirred frequently in a closed vessel under hydrogen atmosphere to minimize the oxidative degradation. After 3 hr. treatment the mixture was rapidly filtered, and the hemicellulose was precipitated from the filtrate by adding threefold volume of methanol acidified with acetic acid to neutralize the caustic. The precipitate was decanted further several times with fresh methanol and the mixture was centrifuged to remove the excess methanol. The xylan content was determined to 89.7% on moisture-free base by the Tollens' phloroglucine method.

The benzylation and acetylation operations were carried out under mild conditions so that the changes occurred in a "polymer-analogous" manner (see Husemann (*7*)). Fifty grams of methanol-wet hemicellulose (dry substance 2.28 grams) were dissolved in about 100 ml. of boiling water in a closed vessel. After

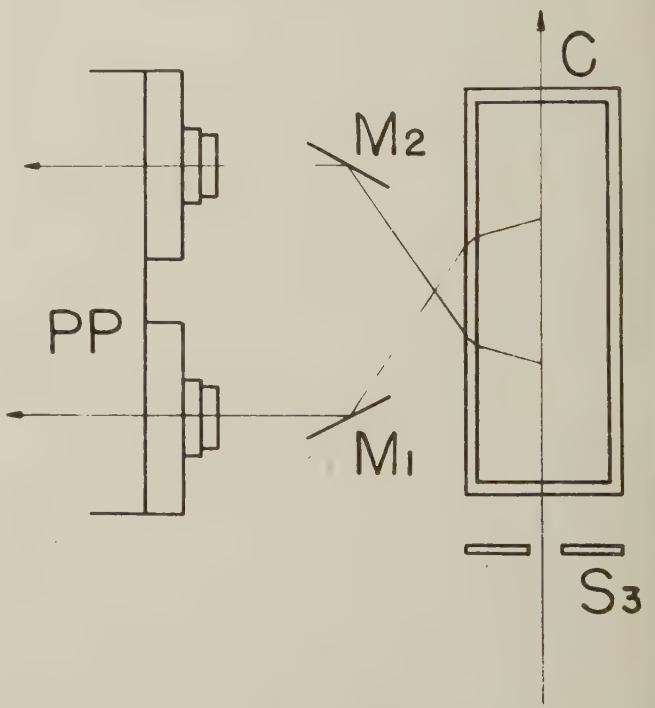

Fig. 2. Schematic illustration of the arrangement for dissymmetry measurements

cooling 40 grams each of sodium hydroxide and benzylchloride were added, and the mixture was heated at 100°C. on a water bath for 8 hr. under hydrogen atmosphere, stirring mechanically. The product was poured into a mixture of methanol and ether, and filtered. The

residue was washed thoroughly with water, the water was replaced with methanol, and finally the methanol with ether, and the residue was dried at 40°C. The crude benzyl xylan obtained weighed 4.47 grams and was 1.96 times the original xylan weight.

Three grams of the crude benzyl xylan were dissolved in a mixture of 60 ml. of pyridin and 60 ml. of acetic acid anhydride. Acetylation was carried out at 60°C. on a hot water bath for 20 hr., and the mixture was poured into ether after cooling. The precipitate was filtered, dissolved in chloroform, and precipitated again by ether.

The product thus obtained was a white powder and soluble in chloroform and dioxane. The result of the chemical analysis agrees with the composition of monobenzyl monoacetyl xylan as shown below:

$C_5H_6O_2(OC_7H_7)(OCOCH_3)$
Theoretical C = 63.63%, H = 6.06%, CH_3CO = 16.29%
Experimental C = 62.30%, H = 6.11%, CH_3CO = 15.50%
Theoretical molecular weight of a unit = 264

For the light scattering measurements the product was further purified by repeating precipitation several times from chloroform solution.

Preparation of Solution

The product was dissolved in dioxane. It is of utmost importance to purify this solution prior to the measurements, since the accidental existence of foreign particles or agglomerated molecules whose sizes are greater than the scattering molecules may materially disturb the measurements. For fear that the product may contain a small fraction of molecules which had not been duly benzylated and acetylated and, accordingly have a tendency to associate into larger particles in dioxane, a small amount of water was added to the solution until it became slightly turbid. The less soluble fraction causing the turbidity was removed by centrifuging the solution at the field of 15,000 G for about 40 min., and the supernatant clear liquid was separated. An excess of water was added to it to precipitate the solute freed from less dispersed fraction. The precipitate was filtered, washed with water, and dried in vacuum at room temperature. Due attention was paid during these operations so as not to introduce any impurities.

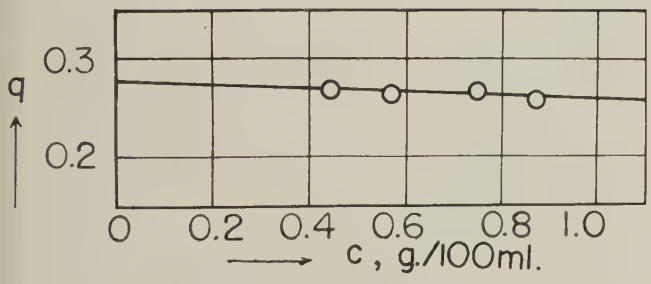

Fig. 3. Plots of dissymmetry coefficient versus concentration

The product thus purified was dissolved again in dried and freshly distilled dioxane, and the solution was filtered through the finest glass filter and centrifuged again. The upper layer of the liquid was subjected to the measurements.

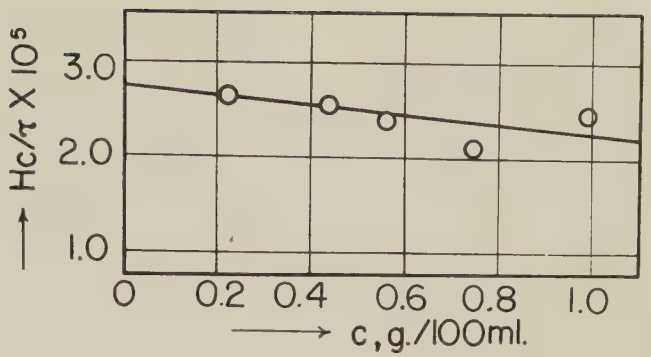

Fig. 4. Plots of Hc/τ *versus* c

RESULTS AND DISCUSSION

Polystyrene Latex Suspension

The ratio of the reading of scales on the dial D_1 to that of dial D_2 was 0.930. The turbidity τ_s was calculated by equation (1) to $1.21 \cdot 10^{-2}$ cm.$^{-1}$, placing d = 6 cm.

The dissymmetry coefficient q was determined from the measurements at 45 and 135° to be 0.70. The ratio D/λ' where D the diameter of the sphere is 0.30 according to the table calculated by Doty and Steiner. The particle scattering factor at 90°, $P_s(90)$, and the dissipation factor Q_s are found also from their tables: $1/P_s(90) = 1.439$ and $1/Q_s = 1.409$.

Dissymmetry Measurements of Benzyl Acetyl Xylan Solutions

Relative intensities at angles of 55 and 125° were measured, and the values of $q = I(55°)/I(125°) - 1$ were plotted against c, as is shown in Fig. 3. The limit value of q extrapolated to the zero concentration, i.e. $[q]$, is determined to be 0.28. The ratio R/λ' for the monodispersed and the polydispersed random coils can be found from the tables calculated by using respectively equations (3) and (4). The results are given in Table I.

Table I. Dissymmetry of Benzyl Acetyl Xylan in Dioxane

$[q] = 0.28$ at 55 and 125°
$\lambda' = 5461/1.422$ A

	R/λ'	R, A
As monodispersed random coils	0.23	880
As polydispersed random coils	0.20	770

Since the sample is an unfractionated one, it is more reasonable to assume the polydispersed system. The particle scattering factor and the dissipation factor are then determined, respectively, to $1/P(90) = 1.263$ and $1/Q = 1.239$.

Turbidity Measurements of Benzyl Acetyl Xylan Solutions

The results of measurements are tabulated in Table II.

The plots of Hc/τ against c are given in Fig. 4. It is interesting to see that the slope of the plots is very small and slightly negative if at all. This suggests that dioxane is not a good solvent of benzyl acetyl xylan. The limit value of Hc/τ extrapolated to the zero concentration is $(2.7 \pm 0.1) \cdot 10^{-5}$. The molecular

weight of benzyl acetyl xylan computed from equation (7) is $M = 45{,}800 \pm 2000$.

Since the weight of a unit element is 264, the DP is determined to DP $= 175 \pm 10$.

The DP of xylan estimated from the viscosity data (in cuprammonium, $K_m = 5 \cdot 10^{-4}$) is 150. The DP's computed by other authors by the viscosity and the osmotic method range also within the same interval.

Table II. Turbidity of Benzyl Acetyl Xylan in Dioxane[a]

Concentration, c (*g. cm.*$^{-3}$) $\times 10^3$	R_s/R $\times 10^2$	τ'(*cm.*$^{-1}$) $\times 10^4$	$\tau = \tau' - \tau_o$ (*cm.*$^{-1}$) $\times 10^4$	$H(c/\tau)$ (*g.*$^{-1}$) $\times 10^5$
9.90	6.0	7.25	6.30	2.45
7.43	5.4	6.52	5.57	2.08
5.54	3.8	4.59	3.64	2.37
4.16	2.9	3.50	2.55	2.54
2.08	1.8	2.17	1.22	2.66
0.00 (pure dioxane)	0.8	0.95 ($= \tau_o$)	0.00	..

τ' was calculated by equation (9) placing $\tau_s = 1.21 \cdot 10^{-2}$ (cm.$^{-1}$), $1/P_s(90) = 1.439$, $1/Q_s = 1.409$, $1/P(90) = 1.263$ and $1/Q = 1.239$.
H was calculated to $1.56 \cdot 10^{-6}$ (g.$^{-2}$·cm.^{2}) by placing $\lambda = 5461 \cdot 10^{-8}$ (cm.), $n_o = 1.422$ and $\partial n/\partial c = 0.112$.
[a] The depolarization constant measured at 90° is as small as 0.007, and Cabannes' factor is practically unity. Therefore, the correction for depolarization was omitted.

Of importance is the shape and size of xylan molecules in the solution clarified by the light scattering method. If the dimension of a xylopyranose residue along the chain be 5.1 A as is the case with a glucopyranose residue in a cellulose chain, the stretched chain length is computed to be $R = 880 \pm 50$ A.

The root mean square distance between the ends of the molecule, measured by the dissymmetry method is 880 A for monodispersed coils and 770 A for polydispersed coils (see Table I).

On the other hand, for a straight rod-shaped molecule, the particle scattering factor is given by

$$P(\theta) = \frac{1}{x}\int_0^{2x} \frac{\sin y}{y}\, dy - \left(\frac{\sin x}{x}\right)^2$$

$$x = 2\pi \frac{R}{\lambda'} \sin \frac{\theta}{2} \qquad (10)$$

where R is the length of the rod. Considering that the dissymmetry coefficient is equal to 0.28 at angles of 55 and 125°, R/λ' can be calculated by the use of equation (10). The calculation results in $R/\lambda' = 0.33$.

In Table III the root mean square distance between the ends of the molecule computed from the dissymmetry coefficient is tabulated together with the length calculated from the molecular weight on the assumption that the molecule is fully extended.

Table III. End-to-End Distance of Molecule of Benzyl Acetyl Xylan

Molecular weight	*Dissymmetry coefficient* q (*at 55 and 125°*)	*Root mean square distance between ends of molecule, A* — *Computed from* q: *Monodispersed coil*	*Polydispersed coil*	*Rod*	*Computed from molecular weight*
45,800	0.28	880	770	1270	880

It is to be seen from Table III that the measured lengths of the molecules correspond on the whole to the stretched-out length computed from the molecular weight. It must be noticed, however, that the lengths determined by the dissymmetry measurement cannot be accepted with finality, because the perfect cleanness of the solution in the optical sense could not be proved. Even a slight concentration of densely packed particle of a size that is greater than the scattering molecules destroys intensely the backward scattered light by interference and will affect materially the observed dissymmetry. Therefore, it may be probable that the q value is slightly smaller (*9*). That the length calculated as the rod is greater than that computed from the molecular weight would be partly due to the assumption that the molecule is a rigid rod. A similar relation is seen in the case of cellulose acetate (*9*).

Table III indicates that the molecules of benzyl acetyl xylan are approximately fully extended in solution. This is similar to the case of cellulose acetate in acetone observed by Stein and Doty (*9*) who indicated that below about 80,000 molecular weight the lengths calculated from dissymmetry measurements corresponded to the stretched-out length within probable experimental error.

Haworth and his co-workers (*6*) concluded that *l*-arabofuranose is present as a terminating unit in a xylan chain, there being one such unit to 18–20 *d*-xylopyranose residues. The primary chains of this type are assumed to be linked together by a type of union involving the free xylose reducing group and the hydroxyl group attached to the 3-positioned carbon atom of a second chain. Considering the value of K_m-constant deduced from the viscosity measurements of xylan solutions, Husemann (*7*) suggested that xylan would be composed of stretched-out chains of xylopyranose residues. Namely the linking of the primary chains happens in such a manner that the end-to-end distance of a molecule is nearly equal to the sum of the lengths of all the primary chains composing the molecule. The light scattering measurements support more definitely the linear structure of xylan molecule.

The linear character of xylan molecule is decidedly evidenced by our finding that xylan membrane shows a prominent birefringence when stretched and crystallizes like cellulose giving fiber diagrams. The x-ray analysis of xylan will be reported in later papers.

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The authors would like to express their thanks to M. Takahashi for his valuable help in making experiments and calculations. They are also indebted to the Department of Education of the Government for financial aid in support of this work and to Nippon Kagaku Sen'i Kenkyusho (Institute for Research of Synthetic Textiles of Japan) for financial support.

RECEIVED Oct. 21, 1954.

An Improved Method for Using Satin White

R. N. THOMPSON

A new concept of the structure of satin white is advanced together with data which show the nature of the formation reaction. It is postulated that satin white is a Werner-type complex held together by hydrogen bonding. A new method of dispersing satin white is presented by which it is possible to produce dispersions of unusual stability. The principle involved is that of coating the satin white with a protective colloid and dispersing the resultant mixture with a polyphosphate. Satin white so treated has a reduced adhesive demand and coating colors of improved fluidity result from its use.

SATIN white is a white pigment used in the paper industry with clay and calcium carbonate in casein-pigment coatings to produce coated papers which have high whiteness, high gloss, good water resistance, and good printing qualities. It was formerly used very extensively, but today its use is largely restricted to specialty coated papers produced by conversion coating methods. The decline of its use is attributable to its high adhesive demand, the difficulties it caused in coating colors, and the fact that most of the properties imparted to the coated paper can be achieved now by other means. However, there are still a number of specialty coating mills where fairly large quantities of satin white are still used.

PREPARATION

Satin white is made by interacting alum with slaked lime. There are two general methods of preparation. One is to add a concentrated alum solution to a lime paste and mix in a high density mixer until the paste is smooth and uniform. The total amount of water used is such that the finished paste will have about 31% air-dry solids. The other method is to spray a 10% alum solution into about a 5% lime slurry until the reaction is complete and then filter press the resulting slurry at about 30 lb. pressure to a paste containing 20 to 25% air-dry solids. In either method the temperature of the reactants should be controlled so that the temperature of the satin white mix does not exceed about 95°F. Either method will produce a satisfactory satin white.

COMPOSITION AND STRUCTURE

The exact composition and structure of satin white have been in debate for years. Probably most of the formulas advanced have been wrong. Sutermeister (*1*), writing on satin white in TAPPI Monograph No. 7, concludes that satin white is probably calcium sulphoaluminate: $3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 31H_2O$.

The titration of lime with alum has been investigated by means of following the pH during the course of the reaction. If a lime slurry of known strength is very carefully titrated with a standardized alum solution and the molal ratio of alum to lime is plotted against pH, a titration curve as shown in Fig. 1 is obtained. This would indicate that there is a series of calcium sulphoaluminates corresponding to molal ratios of 0.142, 0.166, and 0.333. Their formulas may be written as $4CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot xH_2O$, $3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot yH_2O$, and $Al_2O_3 \cdot 3CaSO_4 \cdot zH_2O$, respectively. From considerations of water loss on drying and ignition, the following values are suggested for x, y, and z in the above formulas: $x = 33$, $y = 32$, and $z = 12$. Since satin whites used in the paper industry have pH values between 10.0 and 12.0, they are undoubtedly mixtures of the first two mentioned compounds together with impurities such as calcium carbonate.

Figure 2a shows an x-ray pattern of a satin white paste having a pH of 11.50. This indicates a definitely crystalline material. Its crystalline nature was confirmed by a microscopic examination at 2000×, which revealed very small needlelike crystals which were not resolved at 1000×. Figure 2b shows an x-ray pattern of the same satin white paste after drying for 48 hr. at 105°C. It will be noted that drying destroyed the crystalline nature of the satin white and converted it to an amorphous powder. This would suggest that satin white crystals may be held together by water bridges.

It is proposed here that satin white is a Werner-type complex held together by hydrogen bonding between the OH groups of the lime and the double bond oxygen atoms of the alum. Such a structure could account for the necessity of always adding the alum to the lime, and never the reverse order, in preparing this pigment. In order to have undissociated OH groups attached to

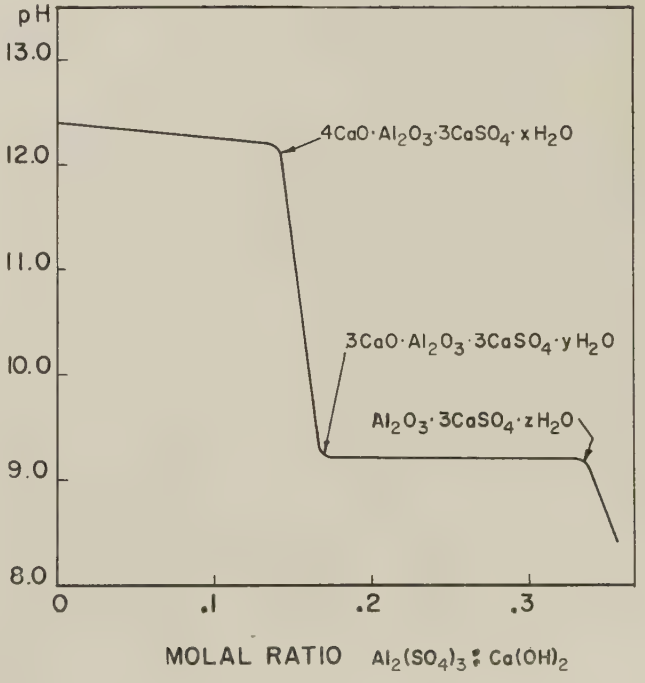
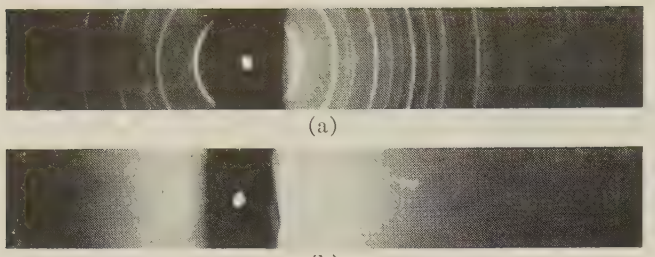


Fig. 1

R. N. THOMPSON, Calgon, Inc., Pittsburgh, Pa.



(a)

(b)

Fig. 2

the calcium atom it would be necessary to maintain the pH of the reaction on the alkaline side. It is seen from the titration curve of Fig. 1 that the $Ca(OH)_2$ groups are complexed in series of 1, 3, 3 $Ca(OH)_2$ groups, respectively in increasing order of the strength of the complex bonds. Thus one $Ca(OH)_2$ group is extremely weakly bound. This may account for the reports of "free lime" in satin white. It has been found that if a satin white paste having an initial pH 11.90 was repeatedly washed with a total of 20 times its weight of water, the pH dropped to a constant value of about 9.8 which is very close to the second break in the titration curve.

The stability of a Werner-type complex is reduced in the presence of another complexing agent whose complexing power is greater. The relative instability of a complex such as satin white probably accounts for many of the apparently anomalous results obtained when satin white is used in coating colors. In addition to being a complex itself, satin white is capable of complexing extensively with water which accounts in part for the high plastic viscosities of satin white pastes of relatively low solids content.

USE IN PAPER COATINGS

In paper coatings, this pigment is used in amounts varying from 5 to 35% of the total pigment. In comparison with clay, its adhesive demand is very high. A high finish conversion coating clay usually requires from a 12 to 15% binder pigment ratio to make a coating which will not pick with a No. 6-A Dennison wax. Satin whites for a comparable strength coating require anywhere from a 50 to 70% binder pigment ratio.

The usual procedure for preparing coating colors containing satin white has been to work up a pigment mixture of clay and satin white in water. The resulting mixture had the consistency of a heavy mud. To this was added the casein dispersion and auxiliaries and mixing was continued until the color was uniform. Several disadvantages were inherent in this procedure, namely that a lot of power was required to pug the clay and satin white, and very often grit contained in the satin white contaminated the color.

A new procedure (*2*) for formulating coating colors containing satin white has been developed which overcomes these disadvantages and offers several other advantages in color preparation. It has been found that when satin white is coated with a protective colloid such as casein and the resulting product is subsequently dispersed with a polyphosphate, such as Calgon, the resulting dispersion of satin white is remarkably stable and is easily blended into coating colors.

If a satin white paste is treated with increasing increments of an alkaline casein dispersion, the viscosity of the paste is gradually reduced until some minimum value is reached after which there is a gradual increase in viscosity. The point of minimum viscosity represents a condition where all the satin white is coated with a protective film of casein which is preferentially adsorbed. The ratio of dry casein to dry satin white at this point is in the range of 10 to 14%. Depending upon the type of mixing equipment used, the time required for optimum mixing is from 30 to 60 min. Following this, the resulting product is dispersed with a polyphosphate such as Calgon. Maximum dispersion stability is achieved with the use of about 1% Calgon based on the dry weight of satin white. Satin white dispersions prepared in this way are stable over periods as long as 1 week.

To formulate a coating color using satin white dispersions prepared as previously described, a conventional clay dispersion and alkaline dispersion of casein are mixed together until the resulting composition is uniform. The satin white dispersion is then added to this and after it is mixed in, the auxiliary agents are added.

In order to illustrate this procedure and the benefits derived from it, a series of colors were prepared and coated handsheets were made from them. The following general formula was used:

High finish coating clay (7.0% moisture)..	50 parts
Satin white paste (31.0% air-dry solids)...	50 parts
Casein (dry basis).....	12.5 to 18.5 parts
Water (total).....	to make 29% total solids

The casein was dispersed at 16.6% solids with 7.0% borax and 7.0% 26° Bé. ammonia. The clay was dispersed at 60% solids with 0.3% Calgon. In the control series, the satin white paste was added to the clay slip and mixed well after which the alkaline casein dispersion was added and mixed until the color was uniform. In the other series, that part of the adhesive dispersion not required by the satin white was blended with the clay dispersion until the mixture was uniform. Separately the satin white paste and a portion of the ad-

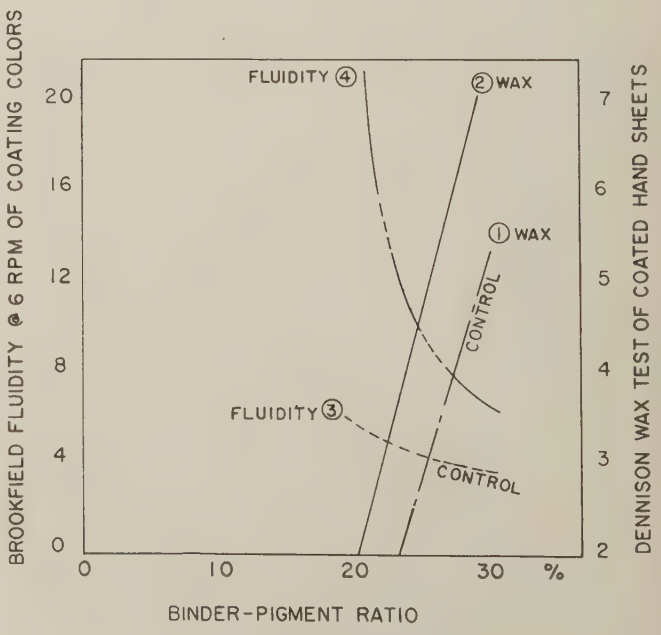


Fig. 3

hesive dispersion, such that the ratio of dry casein to dry satin white was 11%, were mixed together for 1 hr. after which 1% Calgon based on the dry satin white was added and mixing was continued for 15 min. The dispersed satin white was then blended into the mixture of casein and clay. All coating colors were screened through an 80-mesh sieve.

The results of these series are shown in Fig. 3. It is readily apparent that dispersing the satin white by this method has reduced its adhesive demand since no reduction in the adhesive demand of the clay could be inferred. The over-all savings in adhesive is about 12% of the total adhesive. Also the resulting coating colors are more fluid than those prepared by the older method. It has been found that the total solids of the colors could be raised about 5% before their fluidity was reduced to that of the control colors.

CONCLUSIONS

This new procedure for dispersing satin white makes it possible to formulate coating colors containing satin white, which are more fluid, require less adhesive, and which can be made with higher total solids than when older procedures are used. If a satin white paste contains grit, this can be screened out of the satin white dispersion before it is blended into the coating color thereby reducing grit in the color.

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The assistance of G. D. Hansen of Calgon, Inc., in formulating the proposed structural concept of satin white is acknowledged as is the assistance of R. K. Scott of Hall Laboratories in obtaining x-ray diffraction spectra of satin white.

Presented at the Fifth Coating Conference of the Technical Association of the Pulp and Paper Industry, Poland Spring, Me., May 24–26, 1954.

Precipitated Calcium Carbonates

Particle Size-Paper Coating Relationships

GEORGE E. HALL, JR., CHARLES D. McINTOSH, LAWRENCE M. LIGGETT, and ROBERT W. HAGEMEYER

Coated paper properties and the rheological characteristics of the color are determined to a great extent by the particle size and shape of the pigments used. A series of precipitated calcium carbonates all made by a single commercial process and covering a range of particle size from 0.03 to 10 mu was used in this study. All would be considered as fine particle materials but the range here is greater than normally encountered in other coating pigments. Data are presented showing the effect of particle size on adhesive requirement, opacity, gloss, and rheological properties in low solids coatings with several adhesive systems. It is concluded that the particle size required to give optimum value for the various coating properties is not the same. The manufacturer must, therefore, select a particle size which is an intelligent compromise to obtain the most versatile product or make several products to meet special requirements.

THE subject of calcium carbonate and its relationship to paper coatings is not a new one to those working in the coating field. In a brief review of the papers related to calcium carbonate which have been given before the coating conference or published in the paper industry literature, one finds that the subject has generally been discussed from the standpoint of comparing calcium carbonate made by different manufacturing procedures, or by relating properties of carbonates to other coating pigments (*1–4*). As a result of the early exploratory work and the practical experience of many years use by the coating industry, the precipitated calcium carbonates have found their important place as a raw material for paper coating.

The authors have attempted in this study to take a slightly different approach and touch on a phase of this subject which has not been covered in any great detail in the past. Studies on the effect of particle size of precipitated calcium carbonates on end-use properties, have been made for the rubber and for the paint industries, and it was hoped that similar information might be of interest and help to the paper coater. The paper coater is well aware that the particle size of any pigment or pigment mixture going into the coating is an important factor in the results obtained. It may not be generally known, however, that even for precipitated calcium carbonates, made by a single process, a given series of products may cover a particle size range from 0.02 to 10 mu, a factor of 500. On a relative basis this would be like comparing a billiard ball with a two-story house. It is proposed, then, to present data and a discussion on the relation of particle size of a series of products prepared by an identical chemical process and in the same commercial equipment, to some of the more important paper coating properties.

DESCRIPTION OF PRODUCTS

Virtually all precipitated calcium carbonates available on the market today are made by one of three chemical processes. These are outlined in Fig. 1. All the processes have a common starting raw material, namely, limestone which is calcium carbonate. The purpose of the chemical and physical processes involved is to make a precipitated calcium carbonate having properties more suitable for certain industrial uses. The limestone is calcined at a high temperature in a kiln to produce carbon dioxide gas and quicklime. The quicklime is slaked in water; sand, dirt, and other insoluble materials separated; and the resulting milk of

LAWRENCE M. LIGGETT, Supervisor, Inorganic Research; GEORGE E. HALL, JR., Section Head, Pigments Laboratory; CHARLES D. McINTOSH, Chemist, Paper Coating Laboratory; and ROBERT W. HAGEMEYER, Manager, Calcium Carbonate Sales, Wyandotte Chemicals Corp., Wyandotte, Mich.

lime used as a starting material for each of the three processes.

In the first or carbonation process, the carbon dioxide evolved in the burning operation is recombined with calcium hydroxide in the milk of lime to form a precipitated calcium carbonate. In the second process the milk of lime is reacted with soda ash to give caustic soda and a precipitated calcium carbonate. The calcium carbonate is thus a by-product in the production of lime-soda-caustic. It is to be noted in these two

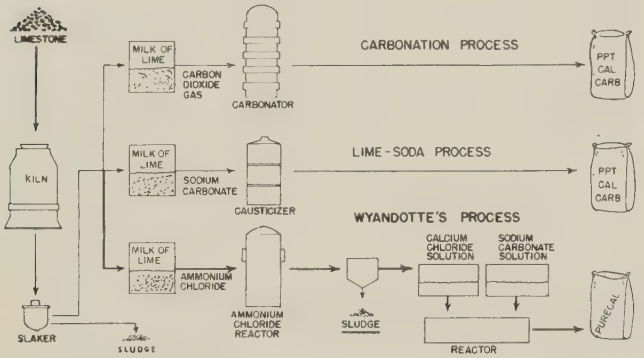

Fig. 1. Manufacturing processes for precipitated calcium carbonate

processes, that there is no chemical purification other than separation of coarse sand and other insolubles from the slaking operation.

In the third process, the milk of lime is reacted with an ammonium chloride solution, an intermediate in the manufacture of soda ash, which liberates ammonia and results in the formation of a calcium chloride solution. This is in effect a chemical purification step. The calcium chloride in turn is reacted with soda ash solution to give a precipitated calcium carbonate. The particle size of the final product is controlled by conditions maintained during this reaction. Filtration, washing, drying, and packaging operations complete the process.

All of the products covered in this paper were made by this reaction in the same commercial equipment. By thus selecting the materials, variations in physical properties, such as crystal structure and particle shape, can be eliminated or minimized. The results of the following coating studies should therefore reflect to a greater degree the effect of particle size alone.

In Table I are shown the more important physical properties of the series of products studied. The physi-

Table I. Physical Properties of Purecals

	D	*M*	*MF*	*T*	*U*
Refractive index	1.66	1.66	1.66	1.66	1.66
Specific gravity	2.65	2.65	2.65	2.65	2.65
Packed density, g./cc.	1.00	0.70	0.60	0.50	0.45
Optical cell brightness	All grades = MgO standard of 100 at all wavelengths				
Slip value, ml. H_2O/100 g.	80	130	180	200	220
Average particle size, mu (electron microscope)	5.0	0.3	0.1	0.06	0.30

cal properties of a pigment itself bear an important relationship to the properties of a coated sheet of paper containing it. Since these products are all chemically very similar and have the same crystal structure (calcite) it is to be expected that the refractive index and

Fig. 2. Purecal D (4–8 mu); ×5200

specific gravity of the entire series would be the same. Apparent or packed density varies, however, the finer products being bulkier than the coarse products. The whiteness or brightness of the series is the same. A high purity precipitated calcium carbonate is probably the whitest of all pigments commonly used in paper coating. The slip value or the amount of water required to make a slip of the product varies from 80 ml. of water per 100 grams for the large particle product to over 200 ml. per 100 grams for the finest product. The average particle size as determined by the electron microscope varies from 5 mu for Purecal D to 0.03 mu for the finest product. As the title of this paper indicates it is the relationship of particle size to coated

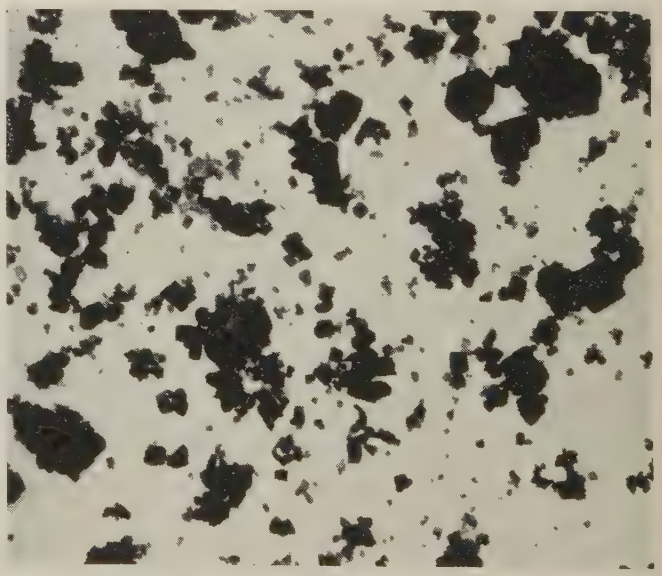

Fig. 3. Purecal M (0.15–0.4 mu); ×30,000

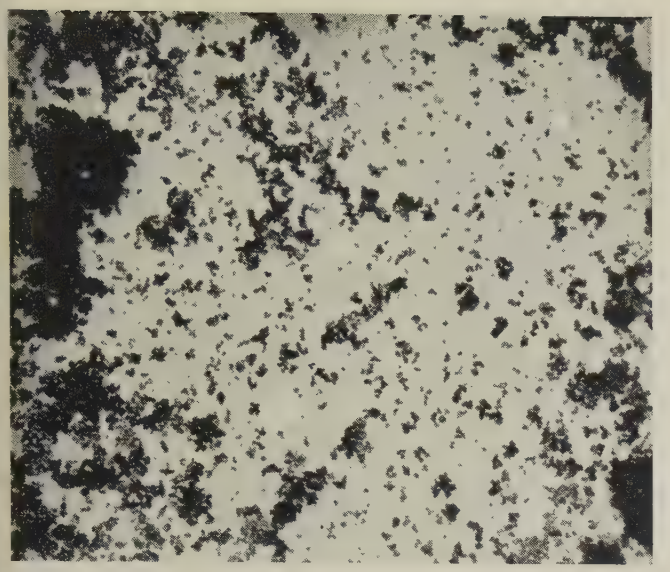

Fig. 4. Precipitated calcium carbonate (0.075–0.15 mu); ×30,000

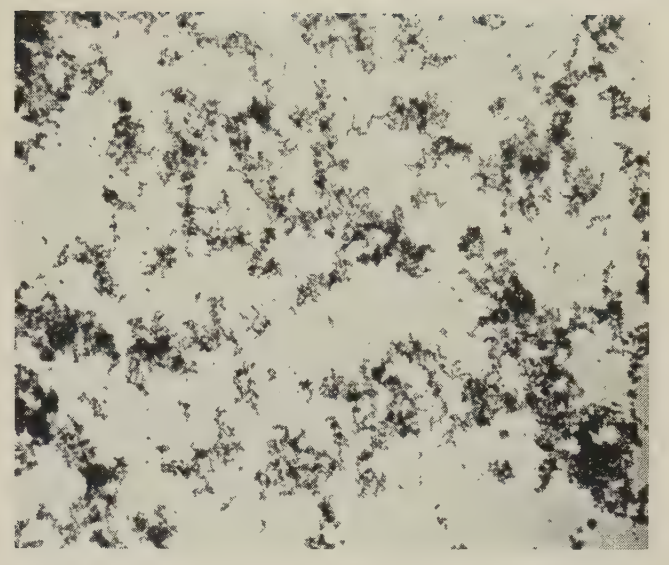

Fig. 6. Purecal U (0.02–0.04 mu); ×30,000

paper properties which is to be discussed. Throughout this paper the product, Purecal D, having an average particle size of 5 mu, will be generally referred to as a coarse or dense product; Purecal M or M Fine having particle size in the range of a few tenths of a micron will be generally referred to as a medium particle size product, while the two members of the series having an average particle size under 0.1 of a micron will be referred to as fine or ultrafine materials. It should be understood, however, that all of these are very small particle products—that even Purecal D is finer than some coating pigments and Purecals T and U are finer than any of the common coating pigments. Electron microscope pictures of the pigments used in this study are shown in Figs. 2 through 7.

EXPERIMENTAL

Color Preparation

Each of the five carbonate products just described was formulated into six coating colors as shown and evaluated. Three of the colors for each product were based on casein adhesive and employed the carbonates as 100% of the pigment composition and with clay in the ratio 30 carbonate–70 clay and 15 carbonate–85 clay. A corresponding series was prepared based on starch. Colors were prepared by conventional laboratory procedure. The pigments were pugged at high solids content using 0.5% Calgon based on pigments as a dispersant. Casein was added as a 1 to 5 mixed alkali-cut and starch was added hot as a 25% slurry. The colors were screened through a 200-mesh sieve prior to coating. The coatings were applied at 45% solids on a 50-lb raw stock using a no. 18 RD Specialties wirewound rod. The raw stock had an opacity of 88 and a brightness of 69. The 45% solids was selected so as to have a workable viscosity level for all the colors in the series. The 100% calcium carbonate colors cover a rather wide range of viscosity. A 12 ±0.5-lb. coat weight was applied to one side of the stock. The coated paper was dried in air, conditioned at 72°F. 50% R.H. for 24 hr. before calendering. The sheets

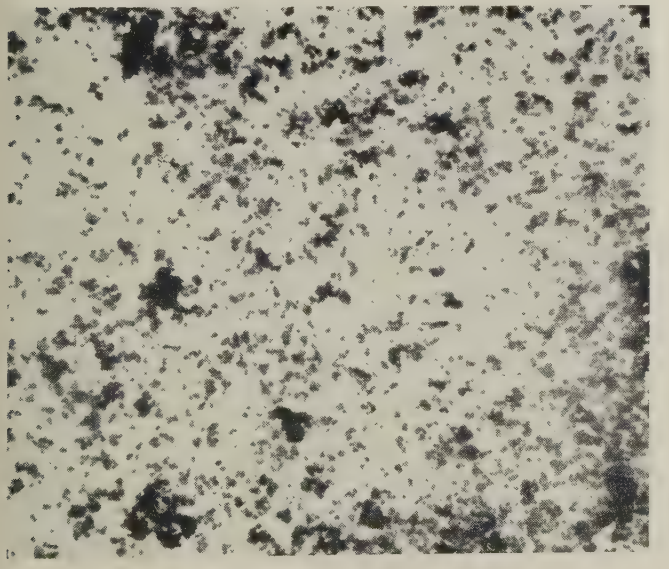

Fig. 5. Purecal T (0.04–0.075 mu); ×30,000

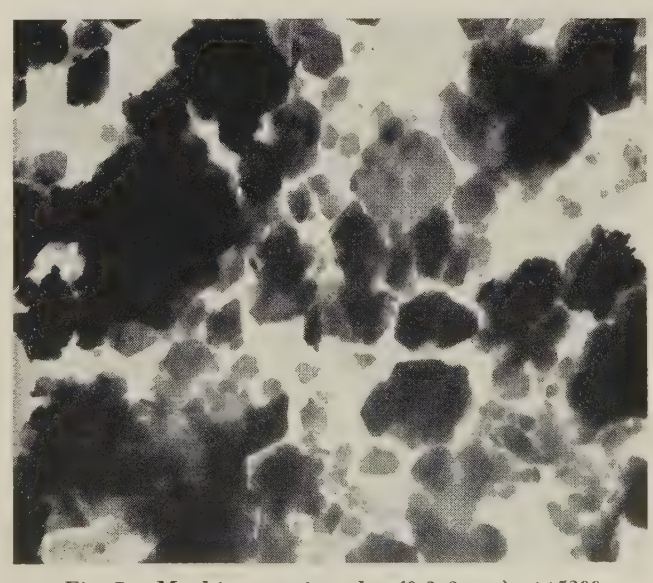

Fig. 7. Machine coating clay (0.3–3 mu); ×5200

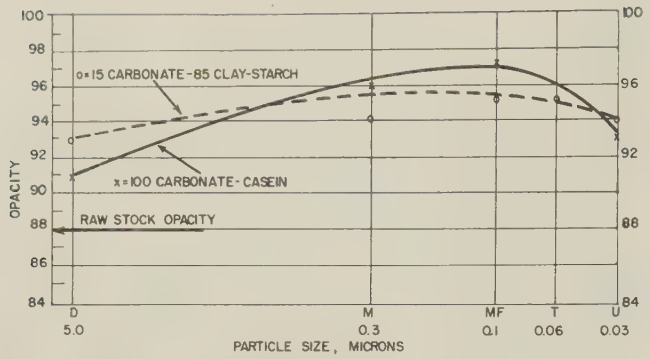

Fig. 8. Opacity versus particle size of precipitated calcium carbonate (TAPPI T 453 m-48)

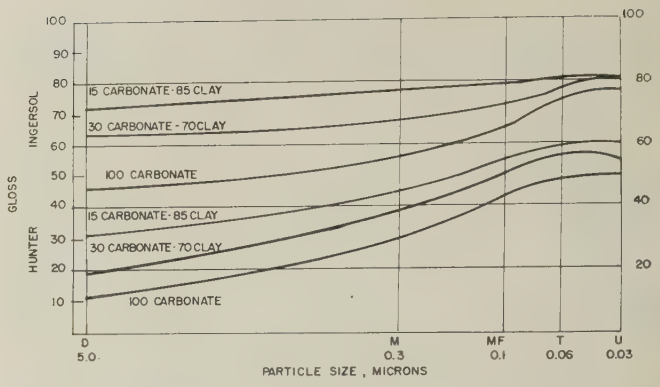

Fig. 10. Gloss versus particle size carbonate-clay-casein-system (TAPPI T 424 m-45 and T 480 m-51)

were calendered on an Appleton no. 411 laboratory calender stack by passing through the nip 12 times. The calendered sheets were again conditioned for 24 hr. at 72°F. 50% R.H. before testing. The coated sheets were evaluated for brightness, opacity, gloss, ink receptivity, and wax pick. TAPPI standard procedures were followed.

DISCUSSION

Opacity

One of the primary functions of a coating is to "mask the raw stock and impart opacity" to the paper (*5*). In Fig. 8 is shown the effect on opacity as the pigment particle size is varied 5 to 0.03 mu. All of the coatings produce a substantial increase in opacity over that of the body stock. The opacity increases with decrease in particle size up to a certain point and then drops off slightly with the ultrafine pigment. In the straight carbonate series there was a 6 point increase in opacity in going from a 5 to a 0.1 mu pigment. This is all the more significant considering we are in the 90 to 97 opacity range. The difference would be much more pronounced at lower coat weight. As would be expected when this series of carbonates was blended with clay the effect between large and small particle carbonates was less pronounced. This may be explained from the fact that the clay used produced better opacity than the large particle carbonate but less than the fine carbonate thereby minimizing the effect of change in particle size of the carbonate.

It has been predicted on theoretical grounds and demonstrated experimentally that maximum reflection from a finely divided pigment occurs at a particle size corresponding to one half the wavelength of the light employed (*6*). For visible light this corresponds to one half of 5500 A or about 0.25 mu. This is close to the particle size of the pigment showing maximum opacity in this study.

By drawing a 1.5-mil film of one series of the colors on Morest hiding power charts as commonly used in the paint industry it was demonstrated that for a given pigment, opacifying power is a function of particle size and that there is an optimum range above or below which the opacifying power is diminished.

Brightness

Most authorities agree that the principal factors affecting brightness of a coated sheet are, brightness of the body stock, brightness of the pigment or coating itself, and hiding or opacifying power of the pigment or coating. Since in this study the same raw stock was used in all tests and the brightness of the calcium carbonates were all equal it will be evident that the net brightness of the coated sheets must depend on the third factor—the hiding or opacifying power of the pigment and coating. Thus the same general trend was found for brightness versus particle size as was found for opacity (Fig. 9). In the straight carbonate series there was an increase in brightness of 13 points (Hunter) in going from a coarse to a medium fine product with a 4 point drop in brightness from the maximum for the ultrafine product. The same effect was noted in the clay-carbonate coatings but to a lesser degree as the clay content increased. This is because of two reasons: first, the lower inherent brightness of the clay, and, second, the good opacifying or hiding power of the clay in relation to the coarse carbonate. Little difference was found between the starch and casein systems; the starch coatings in some cases ran about 1 point higher in brightness.

It was concluded then that brightness and opacity of

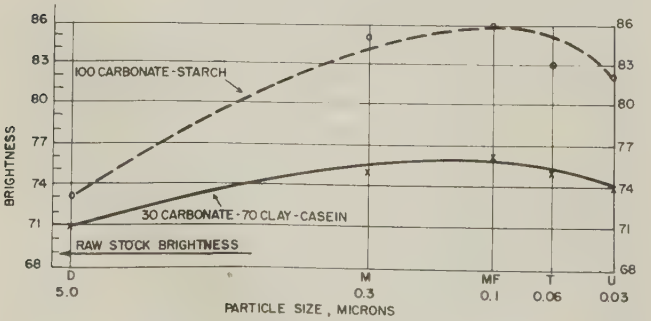

Fig. 9. Brightness versus particle size of precipitated calcium carbonate (TAPPI T 460 m-49)

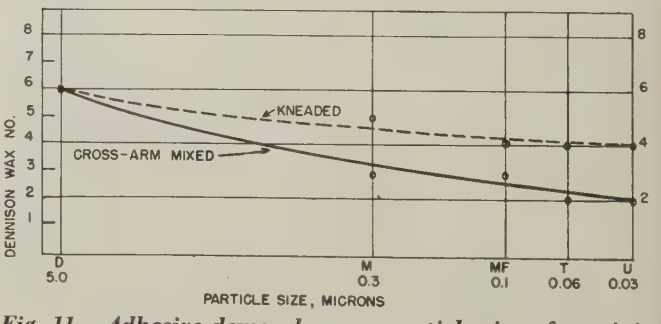

Fig. 11. Adhesive demand versus particle size of precipitated calcium carbonate—effect of kneading (TAPPI T 479 m-49)

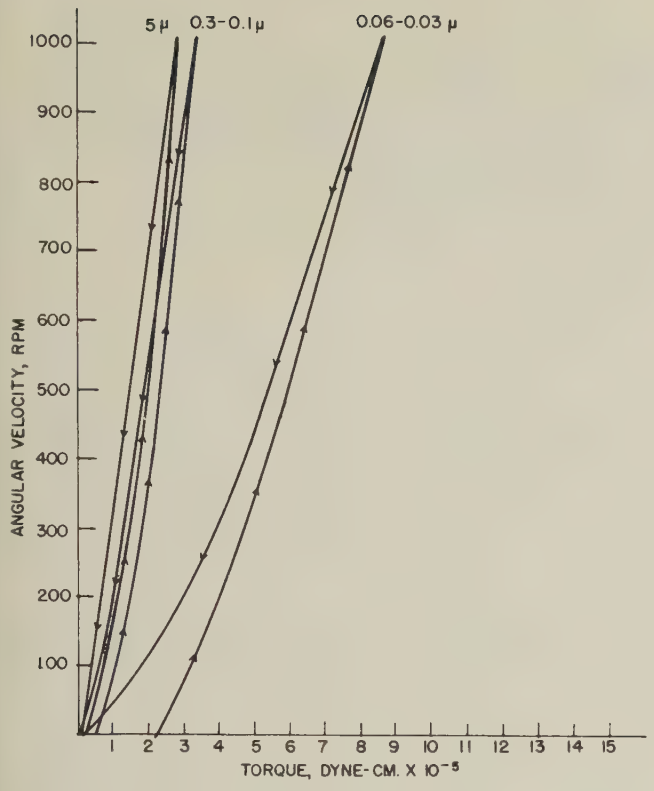

Fig. 12. Relationship of particle size of precipitated calcium carbonate to the flow properties in a 100 carbonate –20 starch color; 45% solids

carbonate coated paper are a function of particle size. Optimum values are obtained with products in the medium to fine particle size range (0.1 to 0.3 mu). Ultrafine and coarse products result in lower brightness and opacity.

Gloss

The development of gloss on calendering is generally considered a requirement for coated paper. The degree of gloss desired will naturally depend on the end-use requirements. It is recognized that gloss depends on or can be controlled by many factors. It is also realized that there is no universal agreement on a definition of gloss or an ideal means for its measurement. For this study the coated sheets were calendered as previously described and gloss measurements made using both an Ingersol glarimeter and a Hunter multipurpose reflectometer. The results are shown in Fig. 10.

It was found that a decrease in particle size resulted

Table II. Coating Color Formulations

	Casein system Pigment	*Starch system* Pigment
Color I	100 parts $CaCO_3$	100 parts $CaCO_3$
Color II	30 parts $CaCO_3$–70 clay	30 parts $CaCO_3$–70 clay
Color III	15 parts $CaCO_3$–85 clay	15 parts $CaCO_3$–85 clay
	Dispersant and adhesive	*Dispersant, adhesive and additive*
	Calgon—0.5 part on pigment Casein—15 parts as 1–5 cut	Calgon—0.5 part Starch—20 parts as 25% solution Soap—1 part as 10% solution

All systems let down to 45% solids with water.

Table III. Adhesive Demand versus Particle Size of Precipitated Calcium Carbonate

	Dennison wax test (TAPPI T 479 m-49)									
	Casein coating					*Starch coating*				
	D	*M*	*MF*	*T*	*U*	*D*	*M*	*MF*	*T*	*U*
100% $CaCO_3$	6	5	4	4	4	6	5	4	4	4
30 $CaCo_3$–70 clay	7	7	7	6	6	7	7	7	6	6
15 $CaCO_3$–85 clay	7	7	7	7	7	7	7	7	7	7

in a marked increase in gloss. It is even apparent in the coatings containing clay as the major pigment constituent. This was true in both the casein and starch coatings. Calcium carbonate is frequently referred to in the literature as a dull finishing pigment. These results show that the finish as measured by Ingersol or Hunter, of the 100% ultrafine carbonate coating is superior to the formulations based on clay and medium grade carbonate.

Adhesive Requirement

Among coating pigments there is a large variation in the amount of adhesive required to meet a certain coating strength. Generally speaking the coarser grades of coating clays are at one end of the scale with satin white having the highest adhesive requirement. Other factors being equal, for a given pigment system, the most important factor affecting adhesive demand is particle size. For the 100% carbonate pigmented coatings, the Dennison wax varied from 6A for the coarse pigments down to 4A for the fine and ultrafine products. The authors were unable to distinguish any differences in adhesive demand between the two finest particle size materials (Table II). In the clay-carbonate systems 6A or 7A wax were obtained in all

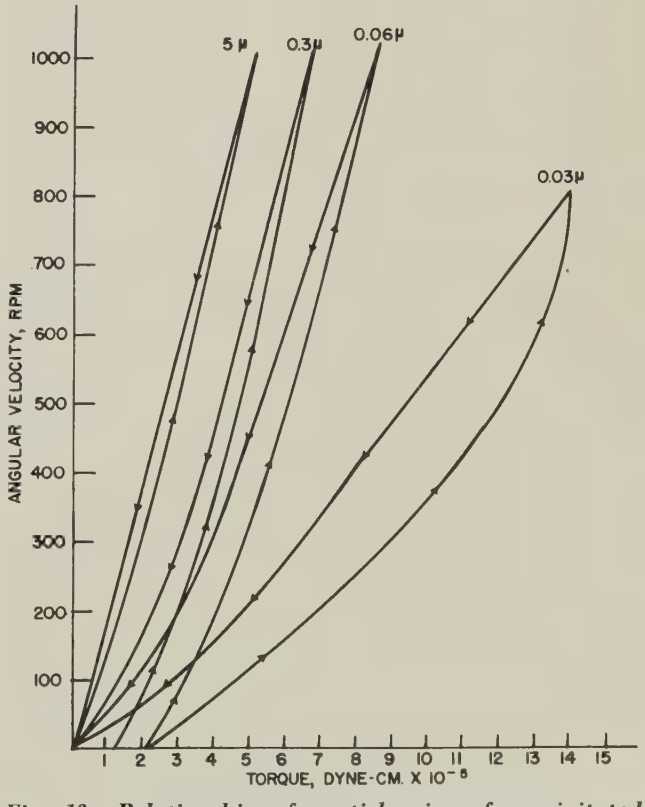

Fig. 13. Relationship of particle size of precipitated calcium carbonate to the flow properties in a 100 carbonate–15 casein color; 45% solids

cases and these were generally body stock picks. Better conclusions could have been drawn from this work had either a stronger coating stock been selected, or a lower over-all level of adhesive been used throughout.

The value of high density mixing of pigments and adhesives to obtain maximum dispersion and optimum results from the adhesive is generally recognized throughout the coating industry. This is illustrated in Fig. 11, which shows a change from 6A to 2A wax in going from the coarse to the ultrafine carbonates, when the colors were prepared by a simple crossarm mixing technique. On the medium and ultrafine pigments, kneading with the adhesive resulted in an average improvement of 2 wax numbers. No advantage was found for kneading the coarse grade of calcium carbonate, a fact which we believe will apply to other large particle coating pigments.

Viscosity

The viscosity of all colors was measured on a Hercules Hi-Shear viscosimeter at 72°F. approximately 2 hr. after screening. Only in the straight carbonate colors did a significant difference show up between the various particle sizes. These rheograms on the 45% solids colors are shown in Figs. 12 and 13. At higher solids substantially greater differences would be expected. The viscosity increased with decreasing particle size regardless of the adhesive system. Furthermore, the degree of thixotropy increased as the particle size decreased. Another factor of importance is the increase in yield value to induce flow with the ultrafine carbonates. Comparing the rheograms of the starch system with those of the casein system it is noted that the starch colors are less viscous. They also have a lower degree of thixotropy. In the 30 carbonate–70 clay and the 15 carbonate–85 clay colors, there were no significant differences in viscosity, degree of thixotropy, or yield value for various particle size calcium carbonates. The colors behaved as Bingham bodies with flow being induced almost with the initial shearing stress.

Ink Receptivity

Ink receptivity is generally recognized as one of the most important factors in printability. Improvement of ink receptivity is one of the primary purposes for coating paper. Precipitated calcium carbonate coatings are generally noted for good ink receptivity and there are several fundamental reasons why this is so. In the first place calcium carbonate has an organophilic character. That is, it has a definite affinity for oils, varnish, and other organic ink vehicles. An example of this may be found in the manufacture of printing inks, containing calcium carbonate, by the flushing technique. In this procedure a heavy paste of calcium carbonate in water is kneaded with the ink vehicle whereupon the carbonate preferentially absorbs the vehicle and releases its absorbed water. In the second place absorption of ink is a surface phenomenon and accordingly should be affected by surface area or particle size of the pigment. This was found to be the case as shown in Fig. 14. It was concluded that precipitated carbonate is a very effective pigment for obtaining receptive coatings and that the particle size

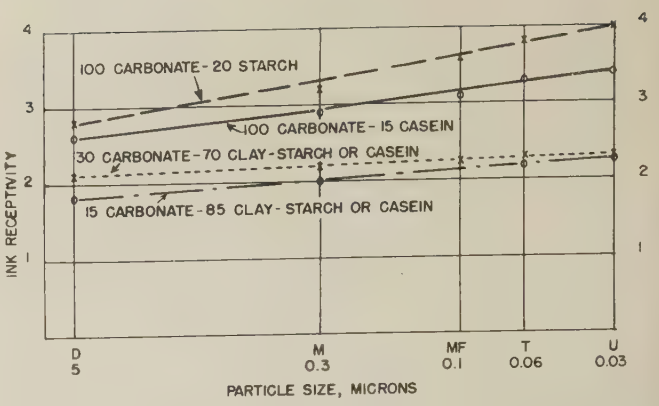

Fig. 14. Ink receptivity versus particle size of precipitated calcium carbonates; K & N ink test (TAPPI RC-19)

largely determines the degree to which the effect is obtained.

SUMMARY

1. It is concluded that optimum opacity and brightness are obtained at an intermediate particle size of the series in the 0.1 to 0.3-mu range.
2. Maximum gloss is obtained only with the ultrafine particle materials.
3. Ink receptivity also appears to increase continuously with decreasing particle size.
4. Adhesive demand as measured by the wax pick test also increases with decreasing particle size.

It is seen then that to obtain maximum gloss and ink receptivity that an ultrafine particle material is required. Maximum brightness and opacity demand a product in the intermediate particle size range. For lowest adhesive requirement the largest particle material would be best. In addition to the foregoing factors the viscosity and rheological properties of the pigments must be considered.

It will be understood from the factors discussed, that the selection of the particle size range for a good paper coating grade product must be an intelligent compromise in the interest of the best all around and most versatile product. It will also be appreciated that the manufacture of high grade paper coating carbonates requires a substantial amount of technical control and evaluation through all steps of the process. The grades of carbonate, with particle size outside that which the authors have selected as being optimum for general use, have application for special purposes. It is foreseen that the finer particle size materials may come into greater utility in the future, particularly as better dispersing agents or improved techniques for utilizing them in color preparation, are found.

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The Application of a Suction Hot Press to the Drier Section of a Paper Machine

J. C. HARPER

The addition of heat to elevate the temperature of a sheet of paper has the apparent effect of increasing freeness of the stock thus permitting more rapid drainage. Experimental data show that the viscosity and surface tension of water decrease as the temperature increases. A heavy duty suction press, preceded by a pre-drier section, was installed in a kraft fourdrinier machine. An overall gain of 12 to 15% in drying capacity was obtained, with decreased steam cost and other tangible gains.

Addition of heat to the forming and pressing section of a paper machine, as an aid to mechanical water removal from the sheet, has been established practice in many mills for some time. Elevating the temperature during the formation period seems to permit more rapid mechanical removal of free water with existing equipment, and with no deleterious effect on the sheet. Raising the temperature of the stock has the apparent effect of increasing the freeness, thereby permitting more rapid and complete drainage.

Various means have been employed in the past to obtain the benefits of higher stock temperatures. Cylinder board mills bring in considerable heat with the stock from the preparation system, and frequently add steam or hot water to the white water system. Some pulp mills have installed driers ahead of the last press to raise the sheet temperature. Steam has been added to the secondary headbox of fourdrinier machines with resulting operating temperatures of 150 to 160°F. Many similar attempts have been made to capitalize on the benefits to be derived from high temperature forming and pressing. In most instances, however, the advantages have not been fully realized because of the inherent inability to maintain sheet temperatures at desirable levels on existing equipment.

In December 1953 a specially designed suction press installation was made in the drier section of a kraft fourdrinier machine producing various grades of liner and corrugating papers. In order to differentiate from conventional press arrangements the installation has subsequently become known as a "suction hot press." It should be clearly understood that the term applies to the complete equipment involved and not the suction roll only.

During the 10 months which have elapsed since the suction hot press was placed in operation it has been possible to evaluate the results obtained from this initial installation. The suction hot press has produced most of the benefits originally expected, as well as some puzzling effects which have still to be explained. From an overall standpoint, the ultimate achievement of more and better paper at the reel at lower cost has definitely been realized. Before proceeding with a description of the installation, and a discussion of performance figures, it should be interesting to examine the theory and reasoning leading up to the decision to attempt this radical departure from conventional water removal practice.

J. C. Harper, Chief Engineer, Downingtown Mfg. Co., Downingtown, Pa.

Fundamentally the problem is three-fold. First, heat must be added to the sheet in such a manner that it will be retained for a predetermined period of time. Second, the relationship between the sheet, felt, and suction box at the nip must be properly maintained. Third, means must be provided for the application of pressures much greater than ordinarily employed. Therefore, based on experience to date, it can be stated with reasonable certainty that the successful operation of a suction hot press depends upon the correlation of three independent variables as follows: (1) heat application to the web; (2) relationship between the sheet, felt, and suction box at the press nip; and (3) pressure application.

HEAT

Established experimental data shows that an increase in the temperature of water decreases both the viscosity and the surface tension. As shown in Fig. 1, the rate of change of the viscosity of water between 50 and 200° is high. At the extremes of the curve, higher and lower temperatures show a decreasing rate of change in viscosity. Since we are primarily concerned in this discussion with temperatures in the range of from 85 to 160° it is interesting to note that the viscosity drop is from 0.8 centipoise to 0.4 cp. The decrease in surface tension follows a straight line as the temperature is increased. Again for the range of 85 to 160° we have a decrease from 71.4 to 65.6 dynes per cm. Palmer (*1*) and Nissan (*2*) show that an equation may be derived wherein for a given short time of relaxation and contact, and for a given felt with a given rate of absorption, the

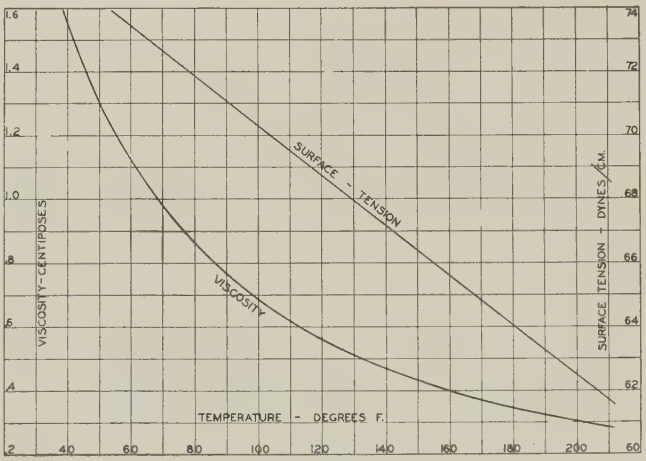

Fig. 1

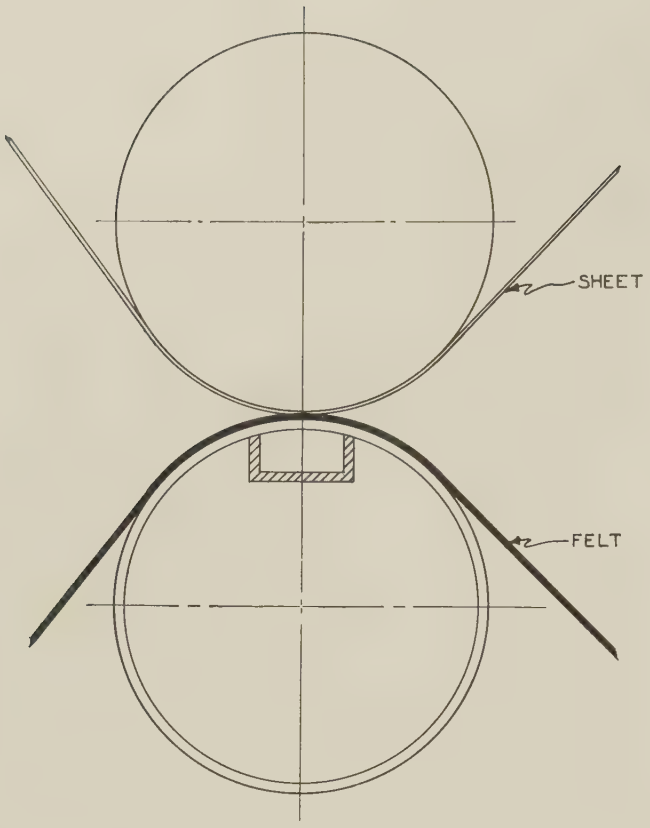

Fig. 2. Relationship of sheet and felt at the nip

total volume of water abstracted by the felt from the sheet is proportional to the square root of the ratio of surface tension to the viscosity of the water. Since this ratio increases with the temperature it is conceivable that pressing at elevated temperatures should theoretically result in an increase in the rate of flow, as the forces required to cause movement have been reduced.

Based upon available data it appears to be unlikely that the temperature of the sheet in the drier section can be elevated much above 160°F. This seems to be true even with the use of a hood, drier felts, and vapor removal systems, since the evaporation of moisture tends to cool the sheet regardless of drier temperature. Following this reasoning, if the sheet temperature could be raised to the vicinity of 160° by the addition of driers, the forces required to move the free water will be considerably reduced.

Continuing this reasoning, if the pressing operation could be continued after the sheet has reached a temperature of about 160°, additional mechanical water removal should be obtained. We would further expect that the expenditure of heat in this manner would be very much less than if steam or hot water is added to the process in the manner previously mentioned. Furthermore, the heat content of the sheet will decrease rapidly through the press section, especially if suction presses are employed.

In order to approach optimum conditions the temperature of the water in the sheet should be as high as possible without actually starting to evaporate water. For this reason the pre-driers are equipped with top and bottom felts, and return felt driers. The hood over the section has no ventilation and is baffled, to cut down natural air movement as much as possible, in an effort to obtain maximum sheet temperature with minimum evaporation.

RELATION BETWEEN THE SHEET, FELT, AND SUCTION BOX AT THE NIP

Figure 2 shows the relationship of the sheet and felt at the nip. Note that the sheet follows the top roll and the felt follows the bottom roll. The sheet therefore is in contact with the felt only at the nip. This narrow nip over an 8-in. width suction box provides means to pull air through the felt both preceding and following the nip. Drying the felt immediately before it meets the wet sheet provides ready and immediate absorption of the free water expressed from the sheet. Following the nip, immediate separation of the sheet and felt will minimize the chance for water to soak back into the sheet. At the same time the water that has been absorbed by the felt is removed as the felt passes over the open portion of the suction roll box. It is estimated that 2 in. of the box width is covered by the top roll, leaving 3 in. on each side of the nip to dry the felt.

PRESSURE

Large diameter rolls were selected in order to obtain high nip pressure without the need for excessive roll crowns. The suction roll is $36^{3}/_{4}$ in. diameter with a $^{3}/_{8}$-in. thick hard rubber cover over the $1^{3}/_{4}$-in. thick bronze shell. The top roll is 39 in. diameter having a 1 in. thick self-doctoring rubber cover. This cover is 45 plastometer P. & J. $^{1}/_{8}$-in. ball. Due to the hot atmosphere in which this roll operates, the apparent plastometer is approximately 10 points softer. This experience suggests that if the roll were to be recovered a

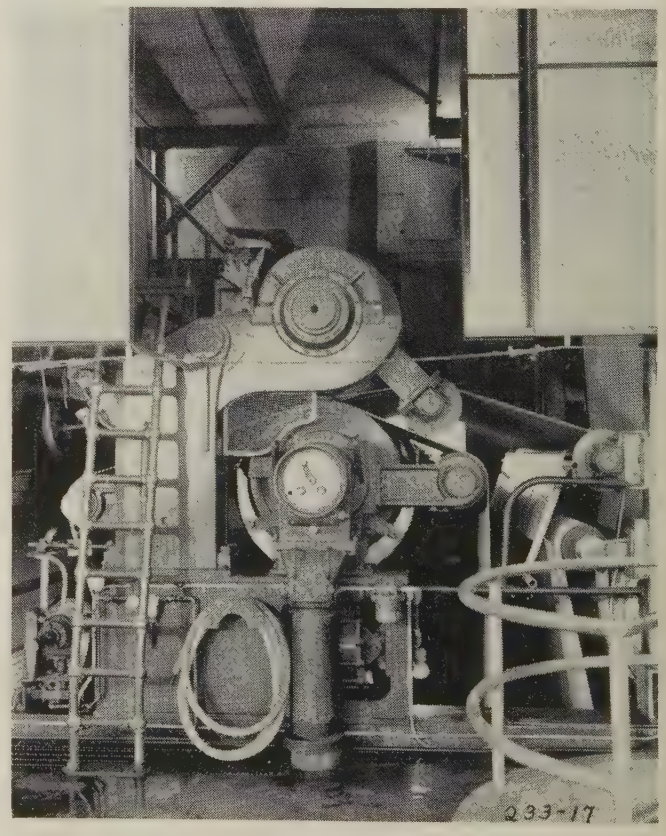

Fig. 3. Suction hot press installation

plastometer of 35 to 40 would be a more suitable recommendation. With rolls of this size the mill has been able to operate with nip loads of 500 lb. per lineal in.

Returning now to a description of the physical arrangement of equipment, the original layout was conventional. The wire is $161\frac{1}{2}$ in. wide by 130 ft. long. The 30-in. diameter suction couch roll is equipped with a 16-in. diameter lump breaker roll. Two $30\frac{1}{4}$-in. diameter rubber covered suction presses and a plain third press preceded the drier section.

Studies of this press section indicated that the plain third press was contributing little or nothing to the dryness of the sheet. In order to provide space for the suction hot press, the third press and ten paper driers were removed. Seven paper driers, with the two felt driers, were then installed immediately after the suction second press. The new suction press was then installed in the space thus made available. All driers are 60 in. diameter by 158-in. face, and are equipped with drier felts. Figure 3 is a photograph of the press installation. Figure 4 is a closer view showing the rope carrier system in greater detail.

The tabulation given in Table I shows operating data recorded before and after the installation of the suction hot press. Prior to the change average condition of the sheet entering the driers was 32 to 33% dry fiber. At start-up the second suction press was temporarily out of service so that the records for January 4 show results using only one suction press and the suction hot press. Comparing the runs of January 4 and January 29 it will be noted that with the second press in operation the sheet was drier leaving the hot press. It should also be noted that there is a small amount of drying taking place in the pre-heaters. It is apparent that the number of driers in the pre-heater section is somewhat greater than required for present operating rates.

Records of test results will show variations depending upon the nature of the sheet, character of furnish,

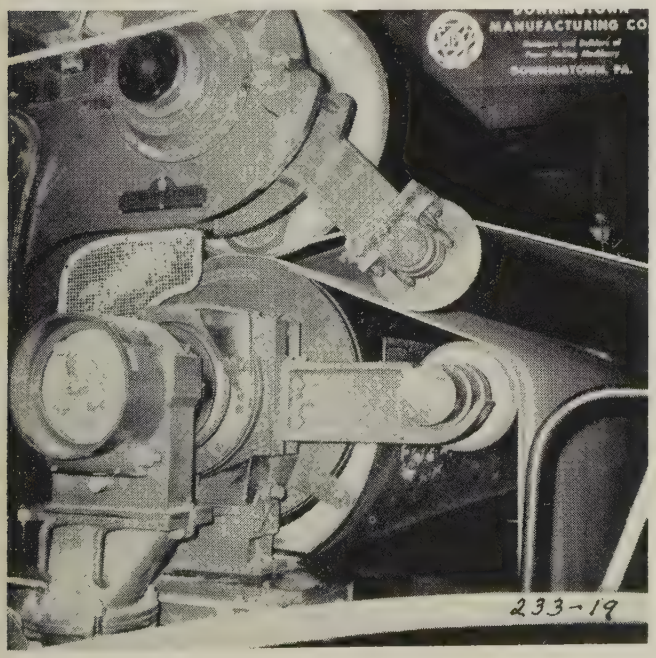

Fig. 4. Suction hot press having rope carrier system

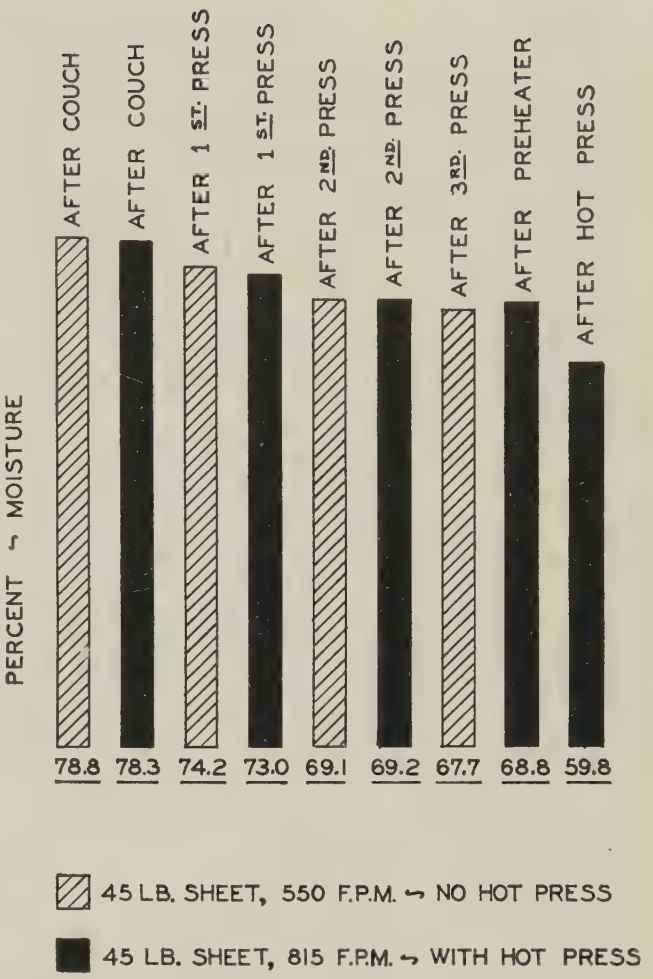

Fig. 5. Comparison of water removal at various stages

condition of the felts, nip pressure, and the like. On 27-lb. corrugating medium the moisture after the hot press is considerably more than the moisture in the 45-lb. liner grades. In this case, the lightweight sheet cannot be pulled too tight and tends to drop away from the top roll, bagging down between the nip and the paper roll following the nip. The resulting contact with the felt evidently permits water to soak back into the sheet and hence the higher water content. Two solutions of this problem have been considered. One is to employ a smaller diameter paper roll which could be moved closer to the nip thus holding the sheet off the felt. The other would be to use a standard rubber compound on the top roll rather than the self-doctoring type so that the sheet would have more affinity for the top roll and not be pulled down by the paper roll.

Comparison of the figures for March 27 with those of January 29 may appear to be disappointing until it is noted that the hot press weighting is lower by 200 lb. Further check into the detailed records showed that the furnish, age of felts, and age of wire were different.

Figure 5 illustrates graphically the comparison of water removal at various stages on the 45-lb. liner grade runs in April, 1953 and January, 1954. The hatched areas represent moisture contents before and the solid sections after, the suction hot press was installed. It will be noted that areas correspond very closely until the sudden drop at the hot press.

In general, it appears safe to say that the hot press is

Table I. Operating Data Before and After Suction Hot Press Installations

Moistures Expressed as Per Cent Dry Weight

Date	2-26 1953	4-5 1953	1-4 1954	1-18 1954	1-29 1954	3-27 1954	2-12 1954	4-26 1954
Weight, lbs.	32	45	45	45	45	42	27	27
Speed	700	550	760	800	815	850	960	960
After Couch	22.9	21.2	..	..	21.7	17.2	19.2	17.8
After 1st Press	30.5	25.8	29.8	33.0	27.0	27.7	22.9	26.2
After 2nd Press	34.1	30.9	Out	35.4	30.8	31.3	28.0	..
After 3rd Press	34.2	32.3	Out	Out	Out	Out	Out	Out
After Pre-Heaters	None	None	30.9	36.5	31.2	33.3	28.9	30.0
After Hot Press	None	None	37.6	41.7	40.2	39.3	34.1	33.6
Nip Pressures—lbs./In.								
1st Press	194	194	205	204	204	197	204	194
2nd Press	212	212	..	212	212	210	212	194
3rd Plain Press	210	210	..	..	..	..	..	..
3rd Suction Hot Press	..	..	337	473	473	275	475	330

removing a considerable amount of water which previously could not be removed mechanically. Since the estimated cost to evaporate water is 10 to 15 times greater than the cost to remove the same quantity by mechanical means, the hot press method certainly deserves consideration. Mill records indicate a 12 to 15% increase in overall production attributable to the hot press. Although the figures are difficult to verify, it also appears that steam consumption per ton of paper has been reduced.

Table II is a tabulation of various tests compiled in an attempt to correlate pertinent data with the hot press operation. As might be expected, considering the pressures involved, caliper was reduced and density increased proportionately. Caliper reduction was in the range of 7 to 9%. This same heavy pressing, combined with suction leveled out moisture content so that tests across the sheet at the reel showed greater uniformity.

At this point, it might be well to discuss some problems experienced, and some areas where the results did not match anticipation.

FELT COSTS

Based on the first 6 months of operation, it appears that felt costs for the hot press are slightly higher than that experienced on the old plain third press. As an example, where the plain press would have averaged about 2.8 lb. of felt per 100 tons of paper produced, the hot press may run something around 3 lb. of felt for every 100 tons of paper produced. Perhaps the shortened felt life is to be expected, since the nip pressures are much greater on the hot press. The determination of the proper type of felt for a suction hot press is still under study. Because of the high pressures involved, a strong felt is needed to stand up under the load. On the other hand, some difficulty from felt marking has been experienced, because of the attempts to get strength into the felt weave. Some difficulty from shadow marking or shell marking on the bottom side of the sheet has been experienced. This problem probably can be reduced by the proper choice of felt.

BURSTING STRENGTH

Initially, it was expected that the use of the hot press would increase the bursting strength. This was speculation, since the reasoning was based on the assumption that when paper is dried the fiber formation is disturbed as moisture makes its way to the surface to be evaporated. It was reasoned that if there is less moisture to be evaporated, there would be less disturbance to the sheet. Figures were available to show that as a sheet passes through a drier section of a paper machine, the original high burst test is lowered as the sheet progresses toward the calender stack. If then the sheet could be sent to the main drier section 41% dry instead of 31% dry, satisfactory burst tests should be obtained without any other change to furnish or jordans. Since this has not been realized a discussion of the reasons why it has not been realized would be welcomed. Perhaps the basic assumption concerning the way paper is dried is faulty. Perhaps the evaporation of water takes place only at the surface and the moisture in the center of the sheet migrates to the surface. Possibly the hot press is removing so much water at one point that the fibers are being disturbed to such an extent that the burst test normally gained from less moisture to be handled in the drier section is lost here. Certainly, a 41% dry sheet coming out of the hot press is not the same as a sheet that has been dried to 41% in the drier section. This appears to be true as picking has been experienced on the drier immediately following the hot press. Even though the total moisture has been re-

Table II. Tabulation of Various Mill Test Records

Date	Speed	Act. Basic weight	Bursting strength	Stiffness with/Across	% Moist.	Caliper	Jordan Power— Bottom Stock	Jordan Power— Top Stock	Steam Pressure— Pre-Heater	Steam Pressure— 1st	Steam Pressure— 2nd	Steam Pressure— Cal.	Steam per ton, lb.	Starch per ton at Cal., lb.
Dec. '53	731	44.7	108.9	85.4—64.8	6.9	0.0131	1350	575	..	80	100	60	6426	11.15
Jan. '54	800	44.9	109.3	86.8—67.5	6.7	0.0122	1615	556	15	70	97	45	5538	9.85
Dec. '53	800	42.2	106.4	78.7—60.2	6.7	0.0124	1248	619	..	100	106	73	6754	...
Jan. '54	805	41.8	102.6	85.8—66.3	6.4	0.0116	1755	575	14	78	98	52	5802	...
Dec. '53	879	38.0	91.7	62.9—50.8	6.9	0.0111	1508	551	..	76	92	57	6528	...
Jan. '54	910	38.7	91.2	68.2—53.1	6.4	0.0106	1652	555	6	56	87	41	5913	...
Dec. '53	1050	32.3	70.8	50.2—39.9	6.6	0.0093	1585	533	..	58	87	44	6098	...
Jan. '54	1050	31.9	79.9	53.5—39.7	6.8	0.0088	1675	535	5	40	82	30	5627	...
Dec. '53	930	27.9	66.1	.. ..	7.4	0.0091	1956	..	..	59	82	..	7144	...
Jan. '54	962	27.7	63.7	.. ..	7.3	0.0083	1669	..	12	42	72	..	6573	...

duced, evidently the pressing action leaves the surface of the sheet wet enough to pick when it hits the hot drier. Two of the questions still to be answered are how to avoid this picking action, and how, if at all, the hot press can increase bursting strength. The picking problem could be reduced by following the hot press with a smoothing press, but at 41% dry the sheet is not in proper condition to receive the full benefits from a smoothing press.

In summation, the proper application of heat and pressure, with the correct relationship existing between sheet, felt, and suction box at the nip permits the removal, by pressing, of water which heretofore had to be removed by evaporation. Specifically, the number of driers was reduced by three (from 54 to 51), drying capacity was increased 12 to 15%, steam consumption per ton of paper was reduced by 8 to 14% depending on sheet weight, bursting strength remained about the same, and caliper was reduced 7 to 9% with increased sheet density.

In closing, a word of caution should be given in connection with use of the data presented. Such data should not be accepted and applied at random to all machines. There are so many variables in the papermaking process from one mill to another that the facts which have been presented should only be used as a guide to determine how effective a suction hot press will be in any particular mill.

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The author is indebted to William W. Clarke of Longview Fibre Co., and James S. Thornton for the mill operating data contained herein.

Received Oct. 16, 1954. Presented at the Ninth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Philadelphia, Pa., Oct. 18–21, 1954.

The Rapid Cycle Digester

LEE E. EBERHARDT

The rapid cycle digester, developed by the United States Gypsum Co. and now marketed by the Bauer Bros. Co., is described. It is presently being operated at the Pilot Rock Lumber Co., Pilot Rock, Ont., the installation at which is given. Indications are presented concerning the application of the process to conventional digesters.

Shortly after World War II, the United States Gypsum Co. as part of its modernization and rehabilitation program desired an automatic device for handling the digestion phase on wood pulps for its felt mill and board operation. Existing equipment at that time was either inadequate, too cumbersome to operate, or required excessive labor and/or time. They wanted a device for cooking wood at pressure ranges not previously utilized. Further requirements were that the unit be adapted to automatic operation in a pulping system, be of simple design, easy to maintain, and efficient in steam utilization.

Various ideas of screw conveyors in horizontal tubes, charging and discharging devices, and batch units were discussed and discarded for a variety of reasons. The final design was an 80-cu. ft. digester of relatively small diameter, with large diameter charging and discharge valves. The original units were designed for tumbling in case a charge hung in the digester. The only moving parts in the unit were the sliding gates in the valves.

Valves of the required design were not available at the time and the Crane Co. was approached to design a 300-lb. 20-in. valve that would cut through a column of chips, open in 5 sec., and stand service requiring operation every 10 min. on a 24-hr. basis. Also required were materials of construction to handle pH values of 3.0 to 4.0 with the corrosive agents being acetic acid and complex organic wood decomposition products. The valves were designed, built, tested, and proved adequate from the service and design standpoint.

Lee E. Eberhardt, The Bauer Bros. Co., Springfield, Ohio.

Six digesters were built and installed in two felt mills and a board plant of the United States Gypsum Co. The units were put into continuous operation in 1947 and 1948 and in most cases have operated continuously since that time. Some early difficulties with packings and materials of construction were encountered but answers were found and, at present, the valves operate for months without downtime for valve slide maintenance.

The Bauer Bros. Co. was interested in this development at the beginning, but could not undertake manufacturing the unit because their product modernization was delayed during the war. Two years ago modernization was completed and an agreement between the two companies was negotiated so that Bauer was licensed to commercialize the rapid cycle digester in the pulp, paper, and board industry.

Shortly after the agreement was made, a new insulation and hardboard project was originated by the Pilot

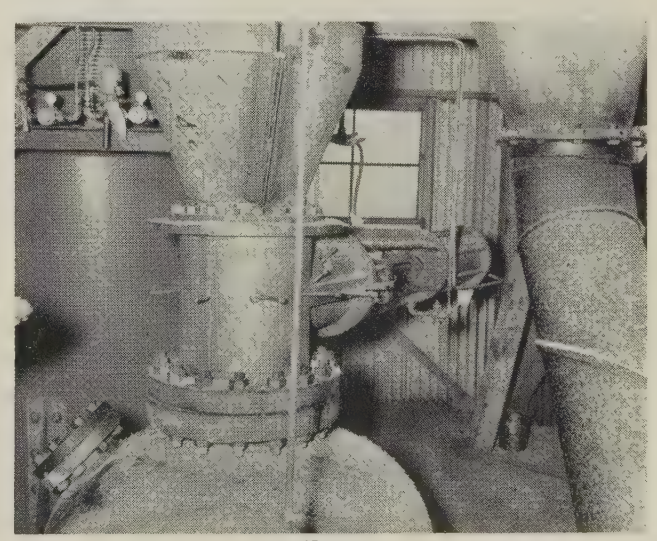

Fig. 1

Rock Lumber Co., Pilot Rock, Ore. The engineers on the project considered all competitive equipment for digestion and pulping, and because of lower capital cost, operating efficiency through automation, and wide range of end-product availability, a rapid cycle automatic pulping system was chosen for this plant.

This contract was unique in that for the first time one company supplied the entire equipment requirements from chip storage to refined stock chest with responsibility for quantity and quality of end product and function of the entire pulping system. The plant was built and has been in operation since March, 1954.

DESCRIPTION OF THE DIGESTER

The units installed at Pilot Rock were 300 p.s.i. stainless pressure vessels 3 ft. in diameter with 12-in. cylinder operated valves top and bottom. The units will hold 120-cu. ft. charges of wood chips.

Figures 1, 2, and 3 are pictures of the rapid cycle digester components installed in the Pilot Rock installation. Figure 1 indicates the top of the digester, the top valve, chip inlet spout, and the surplus chip return.

In operation the chips are elevated to a point above the digesters and discharged into a cross-screw conveyor which conveys the metered charges of chips to the individual digesters. All conveyors are tied into the digester control panel.

Figure 2 indicates the main digester body, the lower valve, and the combination blowpit-vomit stack. The latter is of stainless construction below the bend and polyvinyl chloride dip-coated steel to the top. Figure 3 is a close-up of the lower valve and blowdown. Note the steam jets on the cylinder operated valve seat which are used to sweep the valve seat clean as the valve closes.

Fig. 2

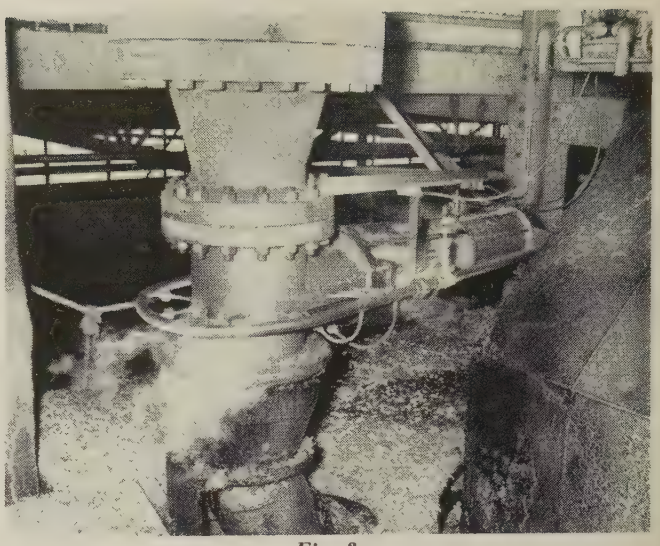

Fig. 3

The rapid cycle digester is a relatively simple cooking device and as an individual unit is not particularly impressive but when it is combined into a complete automatic pulping system, it becomes the basis of an interesting automatic system, and secures the maximum inherent advantages in such a system.

THE RAPID CYCLE DIGESTER SYSTEM

Description

Figures 4, 5, and 6 indicate the additional components required to complete the steamed wood-type system as installed at Pilot Rock, Ore. Figure 4 shows the blowpit, the variable speed drag conveyor, and the refiners. The cooked chips are discharged into the blowpit which is bindicator equipped for level control. The variable speed drag conveyor in turn drags the chips from the blowpit to the openings over the refiners. Any surplus is returned to the blowpit. Control is by speed and slot opening over the individual refiners.

Figure 5 is a close-up of the individual refiners which are equipped with 600-hp. 0.8 power factor synchronous motors. The refiners convert the chips into finished pulp which is discharged into the refined stock chest below the floor.

Figure 6 indicates the system control panel which contains all the automatic and manual controls for all components in the system from the chip storage bin through the refined stock chest.

Operation

Chips are conveyed from the chip storage silos to a bin holding two digester charges on the ground floor of the digester area. This bin insures constant supply to a conveyor elevator which meters the charges for the individual digesters. The digesters operate on a complete cycle from charging to blowdown by present timing devices in the control panel. Operation can be either completely automatic or manual. Any phase of the cook can be changed by resetting the required timer.

The chips are blown at pressures of 25 to 50 p.s.i. into a combination cooked chip bin and vomit stack from which they are conveyed to the refiners. All bins are equipped with high and low bindicators and the

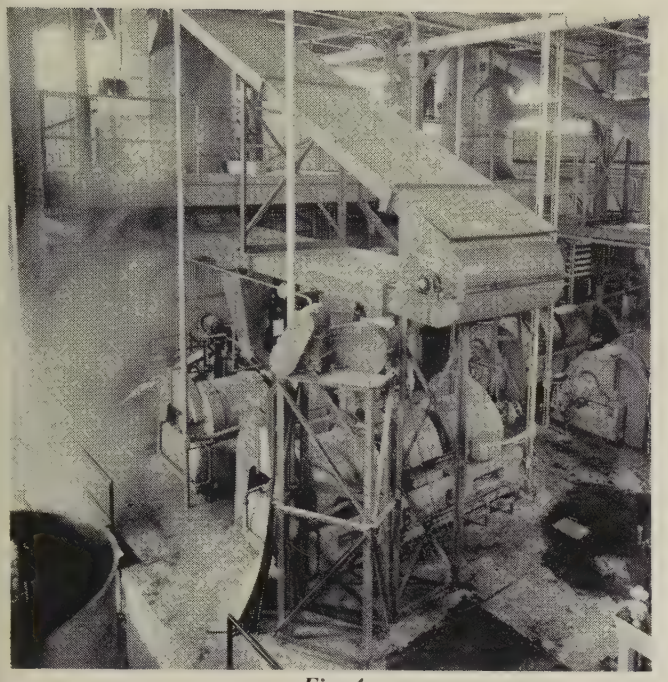

Fig. 4

entire system is adequately protected against malfunction of any working part.

One operator per shift is required to handle the entire system which presently produces in excess of 120 tons per day. Time cycles vary from 6 to 12 min. depending upon end-product requirements and steam consumption is approximately 110 lb. per ton. Blowdown steam is utilized to keep the chips agitated in the blowpits but a direct flash-type heat exchanger could be used to heat process water for the refiners. The output tonnage could readily be doubled or tripled by adding digesters and refiners without increasing labor costs.

When viewed in light of most current operations, the production of 200 to 300 tons per day of pulp by one operator per shift may appear a radical concept, yet the described system has such capabilities.

RECENT DEVELOPMENTS

A laboratory unit of the digester was installed in the Fiber-Products Laboratory at Springfield, Ohio, and research and development work on the unit has been in progress for over 18 months. Most of the activity has been concentrated in broadening the field of application to full chemical, high-yield, and semichemical fields. All of the common cooking chemicals have been tried on a wide variety of hardwoods and softwoods.

It was found very early in this work that little previous study had been made in cooking at steam pressures above 200 lb. Since this is the case, it has been necessary that considerable pioneering take place. The work has been slow and laborious but the fragmentary results on a laboratory basis indicate considerable promise. Some of the data are so unusual that careful checking and rerunning is required to insure accuracy of results.

For example, when southern pine is given a kraft cook to a 45% washed yield and standard quality pulp is produced in 18 min. cover to cover including charging, presteaming, impregnation, cooking, and blowdown, considerable more confirming data are required. These studies are being continued.

Figure 7 indicates the laboratory digester system that has been evolved for this work. It is a small scale unit of the anticipated commercial digester. The external liquor tank is utilized during the impregnation stage to replenish liquor absorbed by the chips.

A typical experimental cook in the digester using the equipment shown in Fig. 7 would be use of a step-by-step procedure as follows:

1. Charge digester with chips.
2. Open blowdown valve and lower steam valve venting air from the digester and introducing steam.
3. Close blowdown valve after venting and raise pressure to presteaming pressure.
4. Exhaust through blowdown valve to 5 to 15 lb. pressure.
5. Pump liquor at high concentration into digester until digester is filled.
6. Apply hydraulic, air, or steam impregnating pressure to liquor supply vessel which in turn supplies the liquor absorbed by the chips.
7. Release pressure and introduce steam through steam valve on top of digester blowing out the liquor. Close liquor valve.
8. Cook in the vapor phase.
9. Relieve to discharge pressure and blow charge.

The above cycle will provide high quality pulps in the 50 to 75% yield range in a cover to cover cycle of 20 min. or less in a commercial unit. Yield and end-product quality can be controlled or varied accurately by changing liquor concentration, steaming pressure, and time factors so as to produce any type of pulp quality required. The cycle can be completely automatic with the one operator requirement being pushing the start button. The cycle will repeat continuously until stopped by the operator or by one of the other system controls.

METHODS OF OPERATION OF DIGESTER

Several methods of procedure can be used for semichemical cooking in the rapid cycle digester. One method is to impregnate the chips with the cooking chemical outside the digester or in a separate vessel utilizing the high pressure digester for carrying out the cooking reaction. A good example would be one in which the chips were sprayed or soaked with a caustic solution, then after a short holding time charged into the digester for cooking.

Another method is to carry out the entire operation of presteaming, impregnation with chemical, and cook-

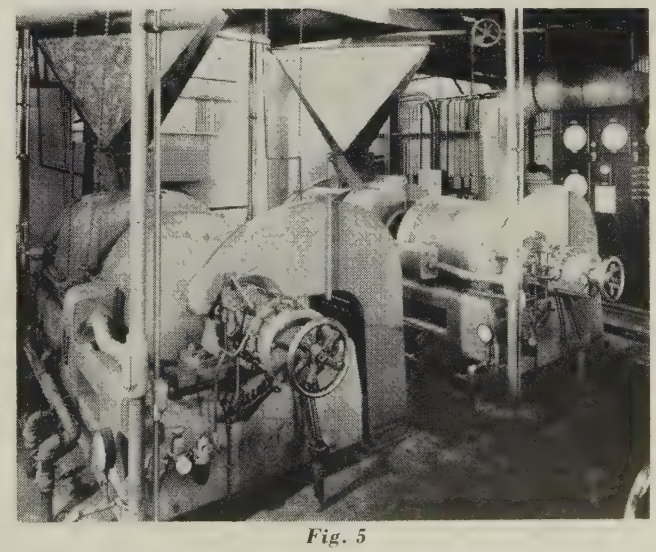

Fig. 5

ing in the digester either in the vapor or liquid phase. The former appears to be the most practical.

The operation and control of the cooking operation can be flexible and accurate. Since relatively short cycles and small batches are involved, the operator can easily and quickly change the cooking conditions to correct for changes in raw materials and end-product requirements. Such flexibility and control should provide excellent end-product quality and uniformity. These factors would provide maximum efficiency in pulping and subsequent operations.

Since all operations are performed in a relatively small vessel, many variations of procedure may be possible that are not practical in conventional stationary or continuous digesters. For example, the chips may be subjected to high pressure presteaming followed by steam blowdown prior to introduction of liquor. Such procedure provides excellent penetration of liquor. Another practical method is the evacuation of the digester with vacuum prior to introduction of liquor.

In addition to these methods of impregnation, further penetration of liquor can be obtained by application of external pressure to the chips and liquor in the digester using hydraulic, air, or steam pressure.

As indicated previously data on full chemical and semichemical cooking in the digester are fragmentary and far from conclusive. Work has progressed to a point where certain observations can be made:

1. The old rule of thumb that speed of reaction doubles for each 10°C. rise in temperature applies in pulping wood in the 175 to 300 p.s.i. steam range.
2. With proper techniques high-yield, bleachable softwood NSSC pulps can be produced using little or no more chemicals than required for hardwoods.
3. There is no apparent degradation of pulps produced using high pressures in the 200 to 300 p.s.i. steam pressure range when compared with pulps produced by conventional methods.
4. High pressure short cycle cooks produce practically identical pulps as compared to conventional cooking methods using the same chemicals and wood species.

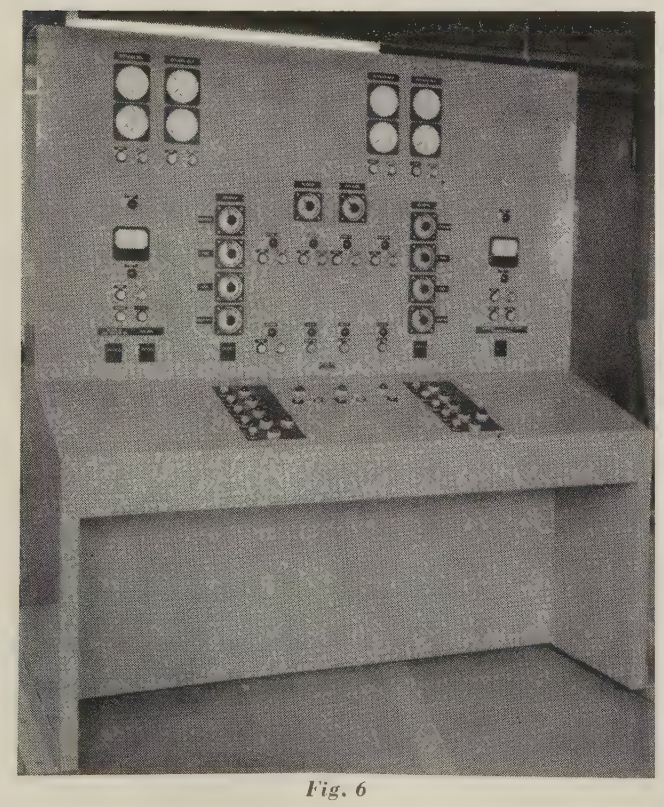

Fig. 6

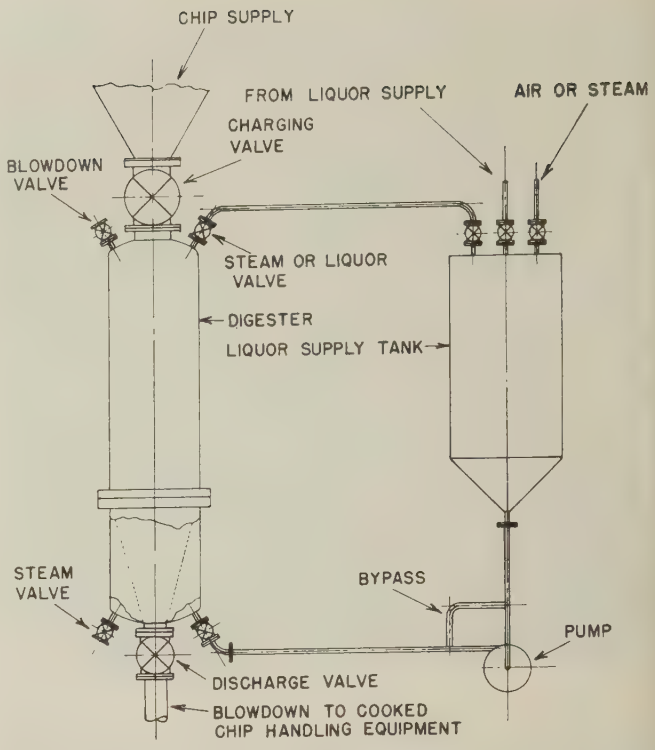

Fig. 7. Schematic diagram of the rapid cycle digester for semichemical or full chemical digestion

This work is continuing and it is anticipated that substantial accurate data on laboratory and commercial operation will be available within the next 6 to 12 months.

APPLICATION OF SOME OF THE RAPID CYCLE SYSTEM PRINCIPLES TO CONVENTIONAL EQUIPMENT

Some of the ideas utilized in the rapid cycle digester system can be applied to conventional digesters and cooking methods with considerable increase in efficiency and reduction of manpower requirements. It is entirely practical to use similar valves of diameters of 24 or 30 in. in place of conventional manhole covers. It is also possible to meter chips at large volumes per minute on time cycle into digesters. Large diameter valves can also be used for blowdown.

One large kraft mill in this country is incorporating several of these ideas on conventional stationary digesters and its management has progressed to the point of discussing closed television circuits for observing the chips being introduced through the top valve into the digesters, such observation taking place at a central control panel and eliminating all labor at the charging floor.

In conclusion it should be pointed out that at this point it is impossible to evaluate or predict the impact of the rapid cycle digester and high pressure cooking on the industry, but indications are that this trend has opened a new field in the study of cooking procedures. This line of development may enable another step forward toward the goal of the complete automation of pulp mills in the not too distant future.

Received Nov. 17, 1954. Presented at the Eighth Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Birmingham, Ala., Oct. 6–8, 1954.

An Experimental Study of the Factors Involved in the Manufacture of Paper Yarn

GEOFFREY BROUGHTON and JAMES P. WANG

Some of the factors such as twist, traveler weight, feed roller design, moisture pickup, surface-active agents, etc. involved in the manufacture of paper yarn were investigated on an experimental twister adapted from a standard cotton twister. Breaking strength of the paper yarn produced was found to be linear with moisture pickup at any given twist per inch, independent of the surface-active agent used. The anionic type of surface-active agent appeared to be the most effective in causing maximum moisture pickup in the short time available during twisting. Concentration of surface-active agent was unimportant provided minimum surface tension was reached.

IF ASKED to examine a piece of yarn or fabric, one usually thinks of the widely known fibers like cotton, wool, rayon, nylon, or the newly developed synthetic fibers like Orlon, Dacron, etc. Paper is seldom considered; yet the making of paper yarn is not a new process. Paper yarn was first produced and patented by Emil Calviey in Germany in 1895. From that time on, it has been used extensively in many different fields. In England and France, paper yarns were developed as a backing for rugs and carpets. In fact, everything except the pile of surface of the rug has been made of paper yarn. In this country, paper yarns have received most attention in the furniture and allied industries. An extensive use of twisted paper yarn at the present time is in automobile seat covers where the paper yarn is actually woven on the loom into fabrics. It is then finished, cut, and fabricated.

Although paper yarns are important, little work appears to have been reported on the factors involved in its manufacture. Such factors are the number of twists to be inserted into the yarn, the weight of traveler used on the ring twister, the amount of moisture picked up by the paper before twisting, and the type of moistening agents used. It is the object of the present paper to study the above factors and to examine their effect on the yarn produced.

PROCEDURE

The experimental procedure will first be described briefly. The machine used to make the paper yarn was a modified extra heavy ring twister such as is used by the cotton industry. A sketch of this machine is shown in Fig. 1. The modified parts are as follows: (1) a pair of front feed rolls (G & H) which have two grooves around them to hold the paper ribbon in the yarn form; (2) the yarn condenser (F), made of porcelain, has a tapered hole in its center to condense the ribbon into yarn form; (3) the bakelite wetting roll (E) and two glass guide rods (D_1 and D_2) are used to moisten the paper before it is condensed into yarn form. The other mechanism is the same as on a standard cotton twister.

The papers used in this work were lightweight tissue. Their properties are listed in Table I.

The paper ribbon is first threaded through the spinning frame as shown in Fig. 1 and the correct gearing selected for the twist desired, the frame is then started and kept running until about 150 yd. of yarn have been made. This amount is considered to be ample for the different tests required. As soon as the frame stops, a few yards of the freshly twisted yarn are pulled off from the bobbin and immediately placed inside a tared weighing bottle. By weighing this wet yarn before and after drying in the conditioning room, the amount of moisture picked up by the paper is determined.

All the paper yarns made were conditioned at 65% R.H. and 70° F. for a period of 24 hr. before testing. Breaking tests were performed with the Instron testing machine (*4*) set at a crosshead speed of 1 in. per min. and a chart speed of 10 in. per min. This gave a magnification ratio of 10 times. The jaw distance or specimen length was 10 in. The results were recorded directly as a load elongation curve from which breaking strength in pounds and elongation in inches were read. The energy absorption capacity or the area under the load-elongation curve was measured directly by use of an electronic integrator connected to the Instron testing machine. All results given in the tables are the averages of at least 10 individual determinations.

RESULTS

Mechanical Factors

The Effect of Twist. Twist is put into yarn to increase its strength. For the common textile fibers it is well known that the strength increases with twist up to an optimum point, above which it decreases. If a graph is constructed with twist shown on the horizontal and tensile strength on the vertical axis, the tensile strength curve will rise to a maximum and then steadily fall. Obviously it is desirable to ascertain this optimum point so that the maximum strength of a yarn can be obtained. Paper yarn is no exception to this behavior and its optimum twist point should be studied before other variables are investigated. Paper A (Table I) was used for this study. Yarns were made using dry and wet twisting conditions, the latter with and without the addition of surface-active agents. Yarns with 2.1, 2.6, 3.3, 4.5, and 5.5 twists per in. were made. Results of the breaking strength tests made on the Instron testing machine are summarized in Table II. Figure 2 reveals clearly that the relationship be-

GEOFFREY BROUGHTON, Lowell Technological Institute, Lowell, Mass., later, University of Rochester, Rochester, N. Y. (deceased), and JAMES P. WANG, Lowell Technological Institute, Lowell, Mass.

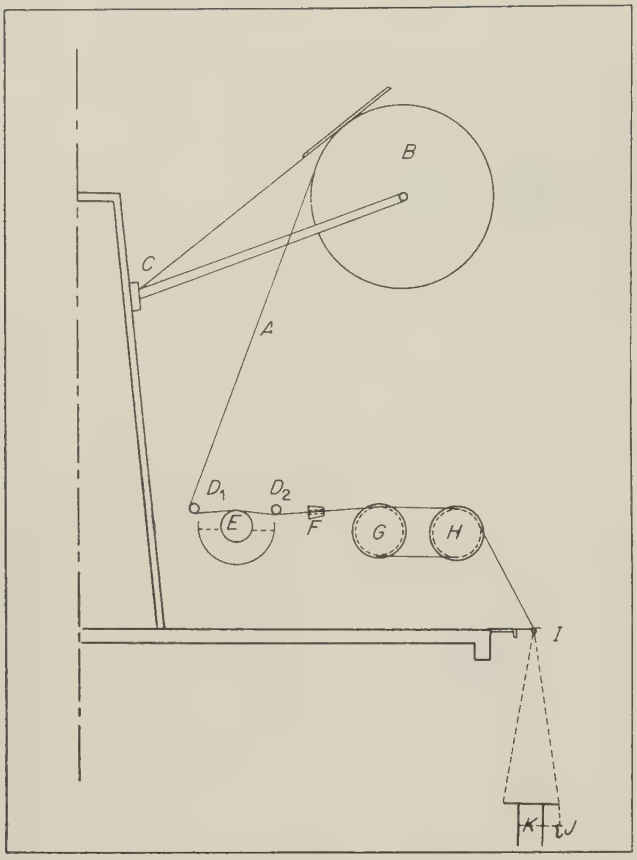

Fig. 1. Sketch of twister

tween the twist of the yarn and the tensile strength follows the same pattern as with other textile fibers and that it is true for all the yarns made, whether by dry or wet twisting.

For both dry and wet (water) twisted yarns, the optimum twist per inch is 4.5 while for the surface-active agent wetted yarns the maximum strength was still not reached at 5.5 twists per in. The rate of increase, however, was much less between 4.5 and 5.5 twists per in. than the rate previous to this point. With the increase in twists per inch, there is a loss in yards per pound, i.e., yield and an additional undesirable increase in per cent elongation. If these two disadvantages are taken into consideration, twists higher than 4.5 twists per in. are not desirable.

To further illustrate the additional undesirable extensibility as twists per inch is increased, two typical load-elongation curves of yarns A and B are shown in Fig. 3. Of these two yarns, A has the lower twists per inch and thus lower breaking strength and extension than B. Assume a load of 4 lb. is applied to both yarns, A and B. It can be seen that this load

Table I

	Paper A	*Paper B*	*Paper C*
Basic weight, lb.	17	12	21
Color	Brown	Black	Tan
Width, in.	9/16	5/8	9/16
Thickness, in.	0.002	0.0018	0.003
Ashcroft burst, lb.	13.1	10.6	21.5
M.I.T. folds	236	904	726
		657 (9/16)	
Breaking strength, lb./in.[a]	12.7	11.9	17.8
Elongation, %[a]	0.79	0.81	0.96

[a] Test strips 3 in. long, performed on Instron tensile tester.

Table II

Tensile Strengths of Yarns (Lb.) at Different Twists per Inch

	Twists per inch				
	2.1	2.6	3.3	4.5	5.5
Dry	4.07	4.01	4.41	4.83	4.52
Wet—H_2O	4.40	4.67	4.88	5.03	4.86
1% soap	4.06	4.36	5.07	5.52	5.66
2½% soap	4.02	4.16	4.69	5.57	5.50
1% Ultrawet-SK	4.48	4.99	5.11	6.08	6.02
½% Detergent-150	4.16	4.71	5.57	6.67	6.89
½% Ultrawet-SK	4.82	5.12	5.41	6.53	6.75
Elongation of Yarns at Different Twists per Inch					
Dry	3.73	3.74	4.42	5.71	6.03
Wet—H_2O	4.61	4.57	5.75	6.96	7.54
1% soap	3.17	3.57	4.09	5.05	5.70
2½% soap	3.16	3.20	4.05	4.90	7.15
1% Ultrawet-SK	3.76	3.85	4.68	5.96	6.78
½% Detergent-150	3.25	3.28	4.21	5.35	6.69
½% Ultrawet-SK	3.68	3.67	4.17	5.74	7.25

stretches the yarn A to only 1.95% while this same load will stretch the yarn B to 2.8%. This is a 43.6% increase. Such a high extension should be avoided if possible since the plastic flow portion is not recoverable or is permanently set. It is obvious, then, that besides the consideration of the increase in strength, attention should also be paid to the change in per cent elongation. Bearing this point in mind, let us go back to Fig. 2. Generally speaking, the tensile strength increases at a high rate up to the 4.5 twists per in. point. After that point the strength either falls off or increases at a much lower rate while the per cent elongation still continues to increase rapidly with twist. The small increase in strength does not compensate for the disadvantages of higher nonrecoverable elongation, slowing down of production, and cumbersome handling. With all the factors in mind 4.5 twists per in. is considered the best twist per inch to be used on this type

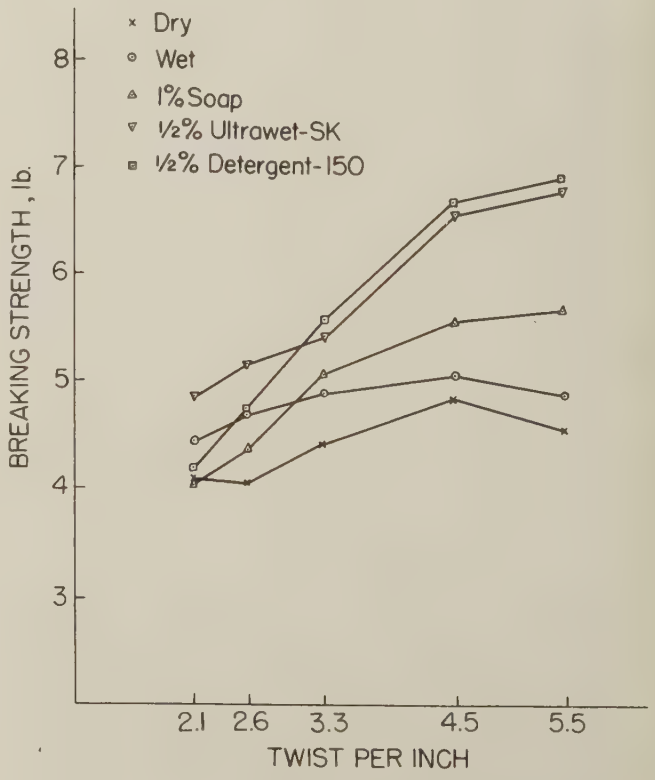

Fig. 2. Twist-strength curves of 17-lb. paper

Table III

	Size of traveler					
	6	7	8	9	10	11
Breaking strength, lb.	7.62	7.36	7.29	6.99	6.86	6.43
Elongation, %	3.99	3.65	4.06	4.88	4.70	4.87

of paper and this twist was used, unless otherwise noted, in all the other experiments run.

The Effect of Size of Traveler. During the twisting of yarn, the traveler J, Fig. 1, is used to serve as a thread guide between the front roll delivery and the winding bobbin. It also inserts twist into the yarn and meantime winds the yarn onto the bobbin. Travelers are made in different sizes and each size is best suited to a certain size of yarn. The weight of the traveler determines to a great extent the amount of backward pull and tension that is exerted on the yarn between the traveler and the bobbin. The use of too light a traveler results in a loosely twisted yarn due to too little tension being applied. It also results in a loosely wound bobbin and may give tangles due to excessive ballooning. When a heavier traveler is used, more tension is developed and exerted on the yarn, thus a more compact and tightly twisted yarn is obtained. There is no definite rule, however, by which to find the right weight of traveler for a given size of yarn. It is best found by actual experiment.

Yarns were made from paper B (Table I) with six different sizes of travelers, nos. 6, 7, 8, 9, 10, and 11. The no. 6 traveler is the heaviest obtainable and the no. 11 is the lightest traveler that can be used without having breakage trouble caused by excessive ballooning. All yarns were made under the same conditions of 3.8 twists per in. and with water containing 0.5% Ultrawet SK so that the results (Table III) were comparable. With rise in weight of traveler used, the tensile strength gradually increases. For the no. 6 traveler, the strength is 7.62 lbs., an increase of 18.5% over the no. 11 traveler. Figure 4 indicates that yarn strength increases linearly with traveler weight. Statistical analysis confirms that strength is significantly improved by change from a no. 11 to a no. 6 traveler. This weight of traveler was used for all experiments unless otherwise noted.

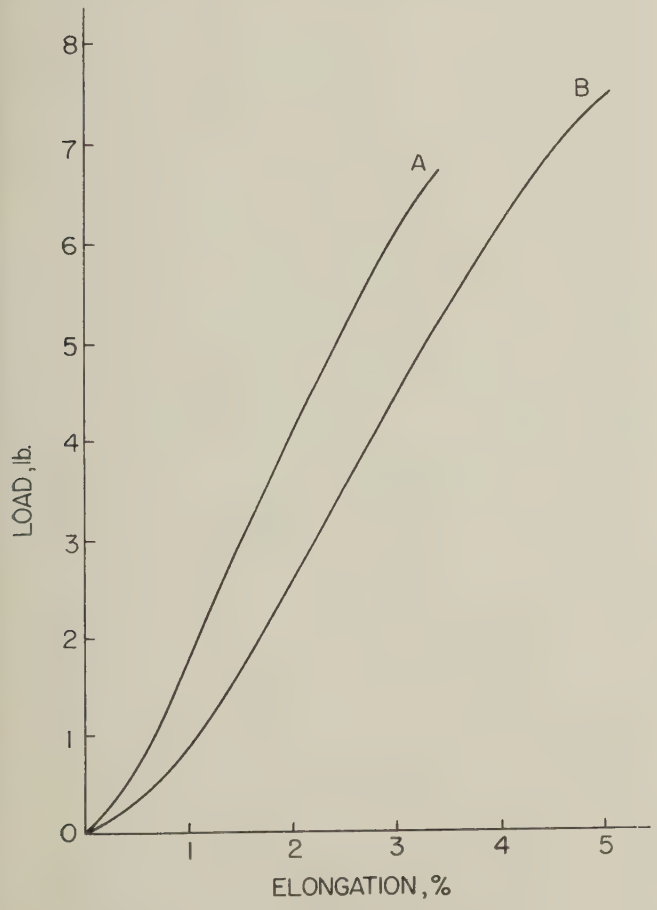

Fig. 3. Load-elongation curves

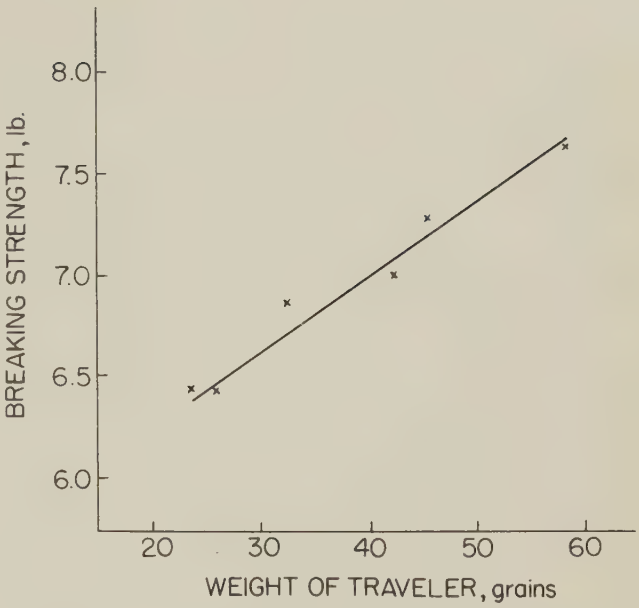

Fig. 4. Traveler weight—strength curve

The per cent elongation decreases with weight of traveler. The heavier weight traveler exerts a higher ten-

Table IV

	Twists per inch				
	2.1	2.6	3.3	4.5	5.5
Breaking Strength of Yarns, Lb.					
Water	5.98	6.06	6.09	5.76	5.55
1/2% Ultrawet-SK	6.73	5.89	6.88	7.15	6.98
1/2% Nonic-218	7.05	7.12	7.02	7.35	7.28
1/2% Quat. A. Cl.	6.56	6.60	6.68	6.91	6.87
1/2% Alrosol	6.87	6.92	7.09	7.45	7.39
1/2% Alrosol-C	6.90	7.11	7.25	7.49	7.38
Elongation of Yarns, %					
Water	4.42	4.60	5.07	5.75	6.27
1/2% Ultrawet-SK	4.14	4.37	4.74	5.24	6.45
1/2% Nonic-218	3.69	3.73	4.01	5.05	5.79
1/2% Quat. A. Cl.	3.72	4.03	4.42	4.76	5.75
1/2% Alrosol	3.72	3.69	3.95	4.76	5.53
1/2% Alrosol-C	3.68	3.88	4.15	4.95	6.01
Wet Pickup of Yarns, %					
Water	19.2	18.4	17.6	17.7	17.9
1/2% Ultrawet-SK	34.9	34.6	34.2	31.7	29.2
1/2% Nonic-218	43.7	39.2	36.4	33.6	32.3
1/2% Quat. A. Cl.	31.7	30.0	29.7	28.2	27.6
1/2% Alrosol	40.1	38.2	37.9	35.8	34.5
1/2% Alrosol-C	54.8	48.2	46.7	35.1	29.6
Energy Absorption Capacity to Break, In.-Lb.					
Water	1.102	1.288	1.461	1.515	1.689
1/2% Ultrawet-SK	1.221	1.339	1.426	1.658	1.972
1/2% Nonic-218	1.153	1.229	1.276	1.724	1.891
1/2% Quat. A. Cl.	1.121	1.219	1.327	1.491	1.861
1/2% Alrosol	1.124	1.209	1.285	1.676	1.844
1/2% Alrosol-C	1.128	1.309	1.423	1.710	1.942

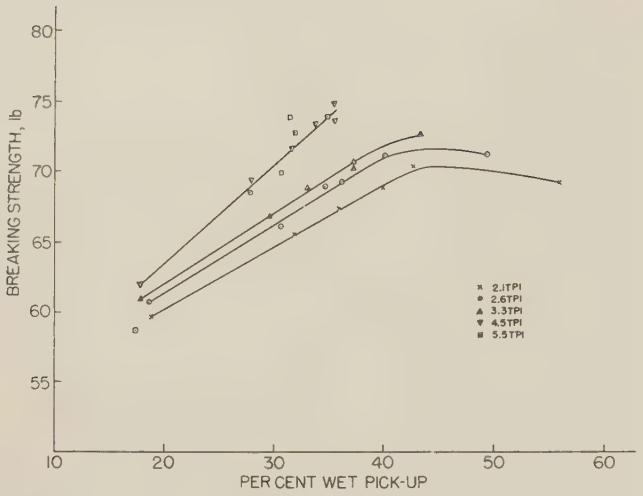

Fig. 5. Wet pick-up—strength curves

sion on the yarn during the twisting and thus stretches the yarn. This is similar to the phenomenon of paper stretching 2 to 7% in length under applied tension.

The Effect of Feed Roller Design. Unlike the rolls used for cotton yarns, the rolls (G, H, Fig. 1) are grooved. These grooves are not only an essential part of the feed but are used to govern the yarn and to keep it in the desired form before the twist insertion. The number of grooves may be two, four, or any other number. Theoretically a four-groove should be better than a two-groove feed roll since there is more surface contact between the yarn and the roll. Thus less slippage should occur as the yarn is fed to the traveler and a more uniform yarn should be obtainable. To test this two groups of yarns were made from paper B (Table I), one using four-groove feed rolls and the other two-groove feed rolls. Otherwise the machine setup was exactly the same for both groups. Identical results were obtained though there was an indication of slightly more slippage occurring in the two-groove feed roll.

The grooves may be V-shaped or flat U-shaped. Visual observation during twisting suggested that the V-shape keeps the paper ribbon in its condensed form better than the U-shape which tends to allow the ribbon to open up before it reaches the traveler. Groups of yarns were made from paper B (Table I) using the two types of grooves. Averages for the two groups were 7.41 and 7.30 lb., which do not differ significantly when analyzed statistically. The conclusion is, therefore, that the number and shape of the feed roll grooves do not affect the strength of the paper yarn.

Chemical Factors

The Effect of Surface-Active Agents. Paper when dry is comparatively stiffer and more brittle than when moderately moist. Because of this stiffness and brittleness is it not customary to twist dry paper, moistening being done before it is twisted into yarn. The simplest moistening medium is water alone, which leads to significantly stronger yarns than dry twisting (Fig. 2). Still better results might be expected with surface-active agents added to the water because of their greater wetting power.

Table V. Summary of Effect of Wetting-Out Agents

Wetting out medium	*Tensile strength, lb.*	*Increase, %*
Soap	6.46	...
Water	6.17	− 4.5
0.5% Oronite ATM	6.71	4.0
0.5% Ultrawet SK	7.15	10.7
0.5% Nonic-218	7.35	13.8
0.5% Alrosol	7.45	15.4
0.5% Alrosol-C	7.49	16.0

Table VI. Effect of Surface-Active Agent Concentration

Concentration of Alrosol-C, %	*Surface tension, dynes/cm.*	*Breaking strength, lb.*	*Elongation at break, %*
0.0	71.7	6.89	3.91
0.01	46.6	6.92	3.78
0.05	35.9	7.03	4.27
0.1	30.3	7.80	4.11
0.2	30.4	7.91	3.87
0.5	30.3	7.79	4.06
1.0	30.5	6.82	4.27
2.0	31.5	8.06	4.11
3.0	32.2	8.16	4.06

Commercial wetting out or surface-active agents available on the market are of three types: anionic, cationic, and nonionic (*3*). One surfactant of each type was chosen, as listed:

Type	*Name*	*Formula*
Anionic	Ultrawet SK	Alkyl aromatic
Cationic	Oronite ATM	Quaternary ammonium chloride
Nonionic	Nonic-218	Polyethylene glycol tertdodecylthioether

Yarns were made up with these from paper B (Table I) at five different twists per inch, the per cent wet pickup and properties of the resultant yarns being shown in Table IV.

It is clear that the nonionic type wets the yarn most efficiently and results in the highest breaking strengths and lowest elongations. At the same time the yarn obtained is most compact and uniform. The stiffness and brittleness of the paper in a dry, improperly wetted twisted yarn prevent the twist being evenly distributed throughout the length. The result is an irregularly twisted yarn, not compact in form and with a rough appearance. The advantages of adequate wetting out of the paper strip before twisting are obvious.

Two other nonionic wetting agents, Alrosol and Alrosol-C, also gave good results, giving further assurance that the nonionic type is the best. Soap, which has been widely used as a wetting out medium in the industry, gave somewhat poor results belonging, as it does, to the anionic type. Table V summarizes the effect of wetting-out agents at 0.5% concentration.

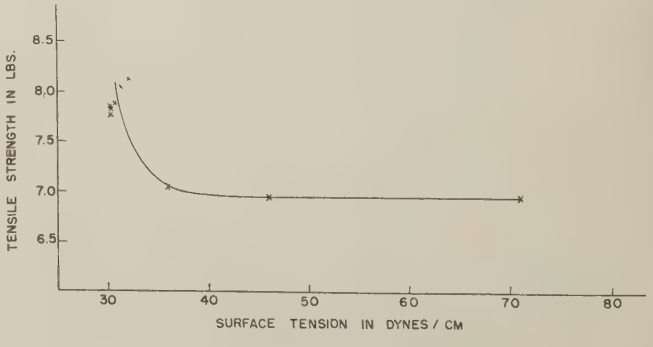

Fig. 6. Surface tension—strength curve

Table VII. Effect of Temperature of Wetting Solution

Temperature	*Breaking strength, lb.*	*Elongation at break, %*
Room (20°C.)	8.81	5.52
70°C.	8.46	5.76

The Effect of Concentration and Temperature of Surface-Active Agent. In order to study the effect of concentration, paper B (Table I) was twisted with solutions, varying in concentration from 0 to 3.0%, of Alrosol-C, the best surfactant found. Surface tensions were measured with the du Nouy surface tensiometer. Results are shown in Table VI.

Paper C (Table I) was twisted with solutions of 0.5% Nonic 218 kept at room temperature (20°C.) and 70° C. Statistical analysis of the results summarized in Table VII indicated no difference in yarn properties; the surface tension of the two solutions were identical.

The Effect of Softeners. Certain water-dispersible aliphatic and wax-type softeners and lubricants are available as substitutes for wetting out agents; some of these were tested at suitable concentrations using paper B (Table I). Table VIII indicates that the wax-type softeners, Lipal 15-S and Alromine RU-100, are

Table VIII. Effect of Softening Agents

Agent	*Concentration, %*	*Breaking strength, lb.*	*Elongation at break, %*	*Energy absorption at break, in.-lb.*
Alrosol-C	0.5	7.49	4.96	1.71
Lipal-15S[a]	1	7.46	4.07	1.37
Nopco-2252	0.5	5.61	7.17	...
Arquad-2HT	0.5	6.27	5.21	...
Alromine RU-100	0.1	7.76	3.87	...
Paper Poduct 2158E	0.5	6.11	5.75	...

[a] 8 traveler used.

significantly better than the others and approach or perhaps equal Alrosol-C in efficiency.

The Effect of Waterproofing Agents. As might be expected yarns made with the agents mentioned above tend to rewet readily in water, a property which may be undesirable. As a measure of this property the Draves tester (*1*) was used. It measures the time for a standard skein to sink in a liquid, when the skein carrying a standard weight is held below the surface of the wetting solution by an anchor. In an attempt to improve rewettability and yet retain yarn strength Quilon, a stearato-chromic chloride complex, was used as a moistening agent on paper B. It is believed that the chromium anchors tightly to the surface being treated and the stearate groups orient outward. Thus the material might be expected to have some of the properties of a lubricant and at the same time confer water repellency through the outward orientation of the stearate group. While the tensile strength obtained is

Table IX. Effect of Quilon (2%)[a]

	Breaking strength, lb.	*Elongation at break, %*	*Energy absorption at break, in.-lb.*
Solution heated	6.71	4.20	1.266
Yarn heated	6.78	4.26	1.264

[a] Twist per inch, 3.8.

Table X. Drave Test Rewetting Times

Quilon	>15 min.
Soap	> 5 min.
Lipal-15S	90 sec.
Ultrawet SK	72 sec.
Oronite ATM	40 sec.
Alromine RU-100	14 sec.
Alrosol-C	4 sec.

not outstanding (Table IX) Quilon effectively waterproofs the fiber (Table X).

DISCUSSION

The results indicate that the tensile strengths of the yarns obtained must be closely related to the water pickup of the paper as it passes over the bakelite wetting roll E (Fig. 1). This pickup will be dependent not only upon the physical properties of the moistening liquid but also upon some function of the paper speed, which in turn is related to the twist employed.

If now breaking strength of the yarns is plotted against the per cent wet pickup fund in their production an illuminating series of curves is obtained (Fig. 5). Breaking strength is seen to be linear with water pickup at any given twist per inch. Only one curve has been drawn for the 4.5 and 5.5-twists per in. yarns since there is little difference between their breaking strengths. It appears, in agreement with Pennenkamp (*2*), that there is an optimum moisture content for any yarn, in this case about 40%. In the present experiments this is reached for the 2.1, 2.6, and 3.3-twists per in. yarns but the two higher twist yarns, because of the speeds involved, do not reach this optimum in the particular series of experiments shown. The importance of an active wetting solution as twists per inch increases is now clear.

Concentration of the surfactant appears to be immaterial as long as the minimum surface tension is reached (Fig. 6). A statistical analysis of the results summarized in Table VI and Fig. 6 indicates that the tensile strength at break is constant at Alrosol-C concentrations of 0.1% and above. The optimum moisture content of 40% was presumably reached in all cases.

To summarize, the mechanical factors influencing ordinary textile spinning are also active in paper twisting. Production of a uniform, high strength yarn is dependent upon the paper having an optimum moisture content before twisting, breaking strength being a linear function of moisture pickup until this optimum is reached. Attainment of the optimum, about 40% for the paper used in the present investigation, is aided by the addition of surface-active agents. Of these, the anionic type are the most effective. Special effects can be obtained with materials such as Quilon, which itself is applied for its waterproofing action.

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Received Dec. 15, 1953. Presented at the 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 15–18, 1954.

Thanks are due to a number of chemical companies for the gift of the treating agents used and, in particular, to the American Twine and Fabric Corp. for many supplies and initial suggestion of this project.

A Means of Inhibiting Capillary Migration of Moisture Within Foundations and Roadbeds of Highways

G. ANGER

Experiments have shown that complete prevention of capillary migration of moisture in the soil is to be accomplished by the addition of comparatively small quantities of agglutinant (spent sulphite liquor with sodium bichromate) andthat damages by frost can be avoided with it.

DURING the more recent years an ever increasing amount of frost damage on roads and highways has been noticed. Unquestionably the increase of both traffic load and above all the number of heavy trucks are contributing factors. Of course the true source of this evil lies much deeper. It is a well-known fact that some roads are hardly, if ever, affected by freezing weather while others, when the warmer season arrives, almost invariably reveal a great deal of damage and require costly repairs. There are a number of attendant circumstances to be considered such as climatic conditions, design and profile of the road (cut in, embankment, slope, etc.), kind of vegetation on adjacent strips of land, distance from the water table below, etc. Aside from these it is primarily the condition of the soil, its degree of granulation, and the grain size to which must be ascribed the varying degree of resistance a road may possess to withstand below freezing temperatures. The capillary action, i.e., the absorbency of a soil increases with decreasing grain size and attains a maximum value at a definite fineness of these grains. During the Winter, this maximum absorbency of the soil in a roadbed gives rise to formation of lens-shaped ice agglomerates, the extent of the area in which they occur sometimes being of considerable magnitude. The arrival of the warm season then causes these parts of the roadbed to become oversaturated locally with moisture, so much so, that the earth material becomes mushy and consequently is unable to withstand pressure from above. As a result, the top layer, lacking support, is soon crushed by the impacts of the traffic load.

The manner in which the ice lenticules are formed is probably as follows. In a most suitable location an ice crystal is formed toward which migrates the moisture of the surrounding soil and upon freezing adds more ice to said nucleus. This migration of the moisture tends toward drying out the soil portion in question, but the capillarity of the latter soon draws moisture from adjacent zones and thereby makes up for the temporary loss. This re-establishing of the moisture equilibrium repeats itself and keeps the moisture moving toward the ice nucleus, thus favoring its growth.

Experiments were made to find out whether spent sulphite liquor is suitable for treating certain kinds of soil, which, when submitted to freezing and subsequent thawing, are likely to cause heaving on highway surfaces. This liquor is a by-product of the manufacture of sulphite pulp and its chief constituent is wood lignin in a sulphonated form combined with calcium.

From the aforesaid it is obvious that merely obstructing the capillary rise of ground water from the foundation into the roadbed will not solve the problem, because the sum total of the water present as soil moisture is carried by capillary action from both sides of the road and especially in a case when snow piles on both sides of a highway protect the soil from exposure to frost while the bare road surface remains unprotected. The possible leakage of water through cracks in the top layer may further aggravate this condition. In view of the aforesaid, the only solution of the problem seems to be to suppress or to destroy capillary activity in all the soil supporting the highway.

EXPERIMENTS MADE IN NORTH AMERICA

Concentrated spent sulphite liquor is being used in road building in the United States and Canada. The State of Wisconsin alone is said to have used 135,000 cu. m. of the untreated spent sulphite liquor on 2500 miles of roads, presumably most of it as a dust binder on unpaved road surfaces. However, quite a number of publications report on its use for improving the load capacity of roads, and in others, reference is made to its utilization as a means of minimizing frost damage. For instance, the Lignosol Chemicals Ltd. at the conclusion of one of its reports says: "Results of treating frost heaving sections of highways have been erratic and remain inconclusive. Further field trials are planned."

The cause of this apparent failure probably lies in the fact that spent sulphite liquor being water soluble is apt to be leached out gradually by atmospheric precipitations. It is also possible that a chemical exchange reaction with the earth material may alter its properties, which possibility appears somewhat supported by statements made in publications that chemical analysis of soils treated with spent sulphite liquor some years ago failed to reveal the presence of the original material but that the soil had acquired an extraordinary hardness.

PREVIOUS WORK

In 1910, an English patent was issued to Wilhelm Haage, Walsum on the Rhine, on a procedure of gelating spent sulphite liquor by adding salts of chromium whereby the material becomes insoluble in water. This procedure seems to produce the kind of material which, when applied to soil, might lessen its absorbency and thus offer a practical method of protecting highways from being damaged by frosts.

G. ANGER, Central Laboratory, Aschaffenburger Zellstoffwerke Corp., Aschaffenburg, Germany.

Preliminary experiments were then made a view to the economical aspect, i.e., to find out the percentage or respective concentration of the expensive chromium salt such treatment would require. The very low water solubility of the gelated liquor was demonstrated by the

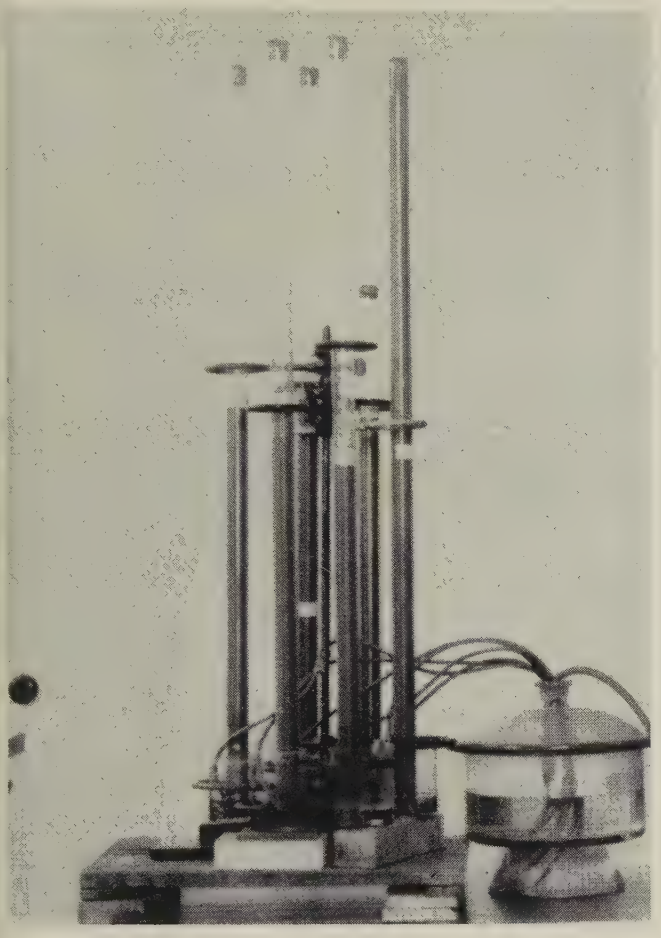

Fig. 1

following experiment made on Aug. 4, 1953. A mixture consisting of 70% sulphite liquor, 30% $Na_2Cr_2O_7$, both 50% solids, and coarse sand was allowed to solidify whereupon it was immersed in water. At the present date, i.e., after 13 months' immersion, this sample does not show any change. To be sure, the water which was repeatedly replaced at first had shown a coloration, but as time went on this coloring effect gradually disappeared. It is thought that this phenomenon may have been caused by an excess of bichromate present in the material.

Further experiments were then made using no sand and mixing only the concentrated spent sulphite liquor (50% solids) with a 50% $Na_2Cr_2O_7$ solution whereupon the gelating effect was watched. The time it took to effect gelation was measured and the following results observed:

Test no.	*$Na_2Cr_2O_7$ added, %*	*Time required for gelation, hr.*
1	20	00.5
2	10	24
3	5	No gelation
4	2	No gelation
5	1	No gelation

Table I

$Na_2Cr_2O_7$ based on dry solids of S.S.L., %	*Time required to effect gelation at pH 7.00, hr.*	*Time required to effect gelation at pH 4.00 (HCl added), hr.*
19	1	3/4
15	2	1 1/2
12.5	6	3
10	20	20
8	No gelation	No gelation

Water was then added to the five mixtures. Numbers 1 and 2 were found water insoluble, while nos. 3, 4, and 5 preserved their syruplike consistency but proved miscible with water. However, this thinning out was less easy and required more intensive stirring than that observed when the concentrated liquor alone was being mixed with water.

In order to find out the minimum amount of $Na_2Cr_2O_7$ at which gelation will take place and also what effect a lowering of the pH value might produce, a series of five tests was run whose results are given in Table I. Both concentrated liquor and gelating agent contained 50% dry solids. Addition of hydrochloric acid evidently was beneficial insofar as it accelerated gelation, but it did not aid in lowering the minimum amount of about 10% $Na_2Cr_2O_7$ required to effect solidification.

Attempts to replace part of the bichromate by bleach-powder, $Al_2(SO_4)_3$, $KAl(SO_4)_2$, or $FeCl_3$ failed to produce the desired results and therefore were discontinued.

APPARATUS AND LABORATORY SETUP EMPLOYED

In order to determine the weight of moisture which various soils are able to absorb within a given time an apparatus was set up as follows: glass tubing of about 1 1/4 in. inner diameter was cut to the desired length of about 30 to 40 in. and into each tube was fitted a one-

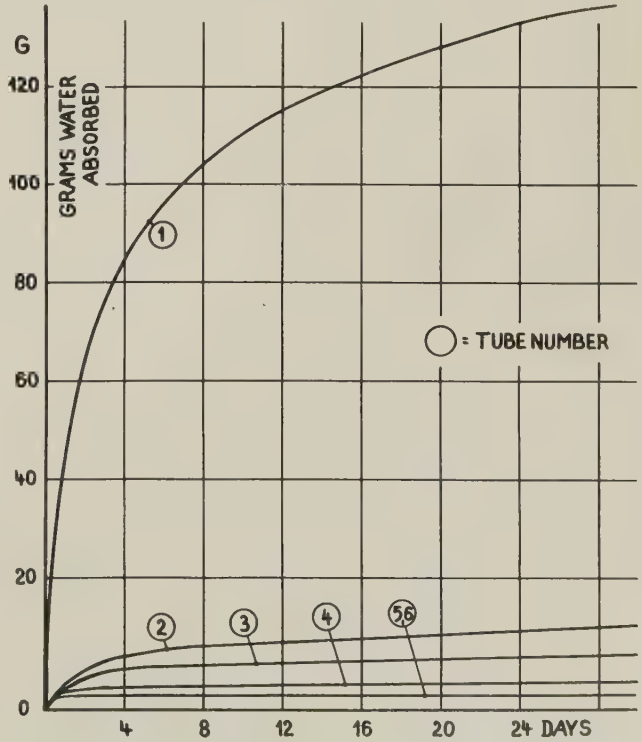

Fig. 2. Absorption of water of the treated and untreated soil nos. 1 to 6

hole stopper. The bore hole was then loosely sealed by sliding in a bobbinlike wick wound from blotting paper, whereupon a few disks of $1^1/_4$ in. diameter were placed in the tube and made to cover the end of the stopper. The soil samples to be tested were then poured into the respective tubes whose upper end was then scaled by means of a stopper, the center hole of which held a capillary tube to prevent loss of moisture by evaporation and at the same time facilitate pressure equalization. The charged tubes after being weighed were placed each in vertical position into a beaker and firmly held in that position by means of clamps suitably attached to a rigid stand. To each beaker water was then added until its level was approximately $^1/_8$ of an inch from the bottom but still was about $^5/_{16}$ of an inch below the soil sample in the glass tube.

The reason for using a wick made from blotting paper and for having the soil rest on disks of that paper was not only to provide a slow but uniform rate of feeding the moisture to the soil, but also to eliminate air binding in the bore hole and to always have the same amount of water adhering to the bottom end of the glass tube. This latter condition was very important since it made it possible to compare the values safely when following up the increasing weight of the tubes during the tests. In order to maintain a constant level in the beakers, a

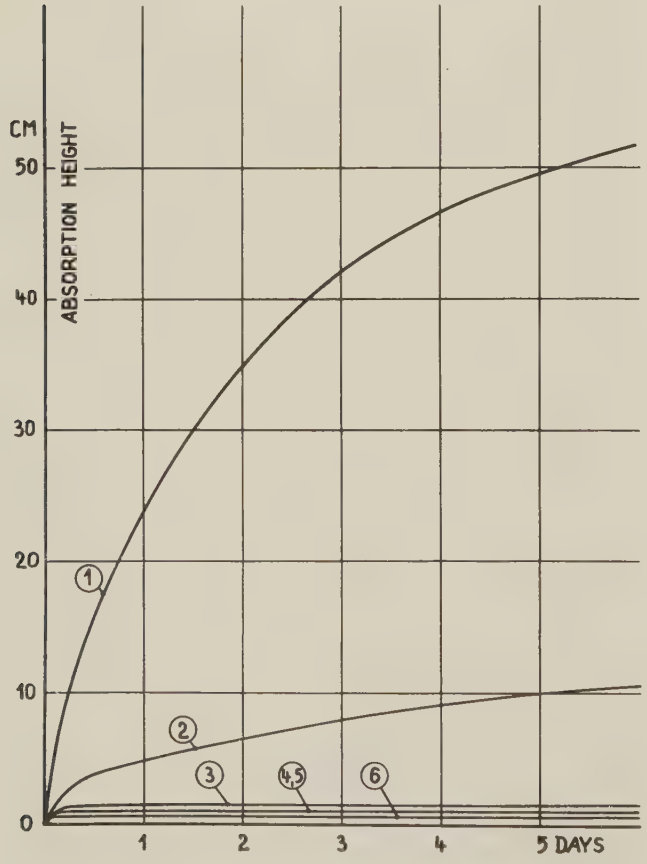

Fig. 3. Absorption height in the samples 1 to 6

desiccator containing an ample supply of water and equipped with rubber siphon tubings was employed to serve as leveling tank. Thus it was necessary but once a week to add some make-up water as a compensation for the water absorbed by the samples and for the unavoidable evaporation in the beakers (see Fig. 1). The water held by the capillarity of the soil samples was then determined by weighing the glass tubes and

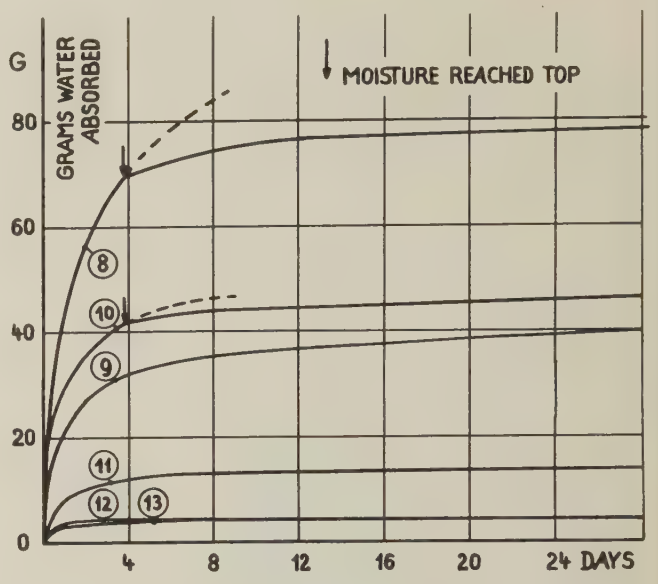

Fig. 4. Absorption of water of the treated and untreated soil nos. 8 to 13

if discernible, by measuring the height of ascent it had reached in the tubes.

EXPERIMENTS

The soil samples employed in the series consisted of vari-colored sandstone from the Spessart Mountains, disintegrated by atmospheric conditions. The material was supplied by the Aschaffenburg Department of Highways and Water Courses and was said to be favoring frost damages. Its moisture weight was 1700 kg. per cu. m.

The method of procedure adhered to in six experiments was as follows: in test 1 a measured weight of the air-dry material (7.1% moisture) was charged into the glass tube and by gently hitting the table top with the lower end of the tube, the soil was densified, whereupon the upper end was stoppered and the filled tube was weighed. In test 2 a measured weight of the same material was first mixed with 8% concentrated spent sulphite liquor, 50% solids, using a Star mix and then was transferred into the second tube and after stoppering it was weighed. In tests 3, 4, 5, and 6 the respective weights of the material were carefully mixed with a binder consisting of 90% concentrated spent sulphite liquor, 50% solids, and 10% of bichromate solution (50% $Na_2Cr_2O_7$) in such proportions that the amounts of binder added corresponded to 2, 4, 6, and 8% dry weight of the respective soil samples. When a sample of the binder placed aside for observation showed that gelation was complete (after about 24 hr.) the six tubes of known weight were placed in working position into the beakers and allowed to remain there for observation of the absorbency of their contents. The data are shown in Table II.

The weight of water absorbed by the untreated soil in glass tube 1 during 28 consecutive days is shown in curve 1 on Fig. 2 and reveals the great absorbency of the material.

Treatment with 8% liquor concentrate alone (tube 2) considerably lowered the capillary activity but as the liquor added is water soluble and remains so in the soil, the possibility of its being leached out should not be overlooked.

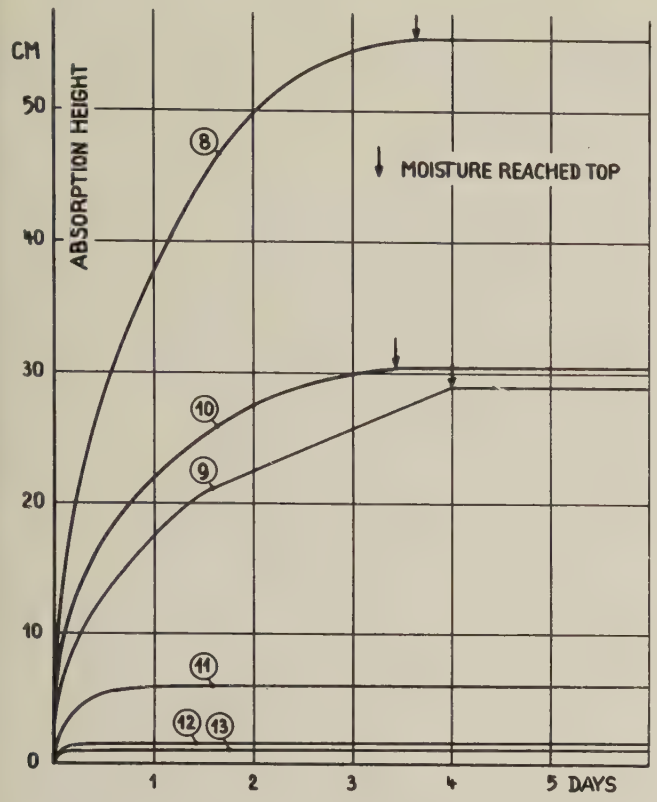

Fig. 5. Absorption height in the samples 8 to 13

Treatment with 2% or respectively 4% of binder (tubes 3 and 4) when being compared with the results observed on tubes 5 and 6, is by far more economical all the more as the binder employed is so insoluble in water that it is capable of resisting leaching out conditions over very long periods.

Figure 3 shows the height in centimeters of the capillary rise. In tubes 1 and 2 the sharp dividing line between the moist and the dry zone soon faded out and after the sixth day was no longer discernible.

In contrast to this it was interesting to note that in tubes 3, 4, 5, and 6 the sharp dividing line at first visible, ceased climbing a few hours after starting the test, and persisted there throughout the entire 28 days' duration of the experiment. Studying the curves in Fig. 3 it becomes obvious that a soil after being treated with 2% of that binder would be immune to frost.

Table II

Glass tube no.	*Binder added to soil, %* — *S.S.L. binder (as 50% solids concentrate)*	*Modified binder (S.S.L. + $Na_2Cr_2O_7$)*	*Density of soil attained, kg./m.³*	*Cost of admixture per square meter of road surface, U. S. dollars*
1	..	..	1200	...
2	8	..	1450	0.76
3	..	2	1200	0.32
4	..	4	1200	0.64
5	..	6	1200	0.97
6	..	8	1250	1.29

However, as the carefully and uniformly mixed material obtained in the laboratory cannot be reproduced under conditions that obtain out on some highway closed for repair work, it appears safer to employ the higher percentage, i.e., 3 to 4%.

The untreated soil had absorbed 137 grams of water in 28 days while that treated with 4% binder absorbed only 6 grams of water in the same period, hence only 4.4% of the former. It is also of interest to know that the untreated soil continued to take up water after these 28 days, while that treated with the binder had reached the saturation point long before the test was ended.

Some more experiments were then made in which the varying moisture content such as occurs in tubes 1 to 6 was adjusted so as to be the same in the tubes 8 to 13. The concentration of the binder was lowered to facilitate its mixing with the soil which in case of a practical application would call for a method of injecting the binder into the roadbed.

Both the concentrated spent sulphite liquor and the bichromate solution were thinned out to 25% dry

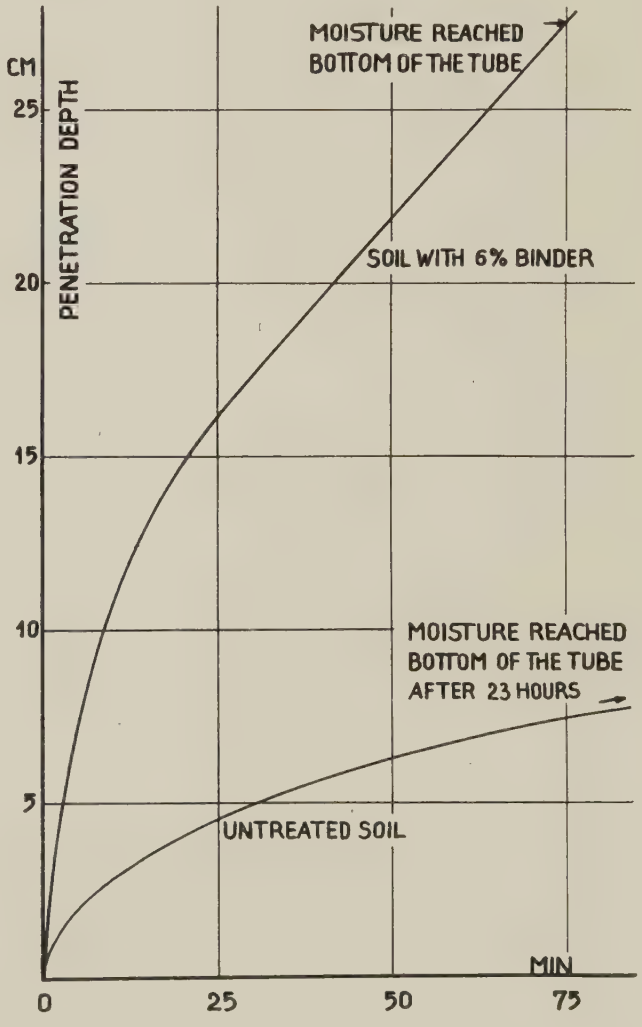

Fig. 6. Penetration of water in the treated and untreated soil

solids, so that regardless of the ratio at which the two agents were mixed, the resulting binder would always contain 25% dry solids. The ratio, thought to be both adequate and economical, was 85% concentrated spent

Table III

Glass tube no.	S.S.L. 25% solids added, %	Modified binder 25% solids added, %	Density of soil attained, kg./cu. m.	Cost/square meter of road surface, U. S. dollars
8	..	..	1660	...
9	8	..	1620	0.38
10	..	2	1540	0.19
11	..	4	1550	0.38
12	..	6	1540	0.57
13	..	8	1540	0.76

sulphite liquor and 15% bichromate solution. The amounts added are shown in Table III.

It is obvious that the soil in tubes 9 and 13 where the largest volumes of liquor concentrate or respective binder were to be added would contain the highest amount of moisture. In order to attain the same initial moisture content in the other samples, a calculated volume of water was added to soil samples 8, 10, 11, and 12 prior to transferring them into their tubes. During the filling of the tubes the soil was densified by means of a cone-shaped plunger. As in the previous tests, the tubes were placed into the beakers when a small sample kept separately had revealed that gelation was complete.

Figure 4 shows the weight of water taken up by the samples. As in this series the amounts of soil employed had been smaller than that in the preceding ones, the tubes were only partly filled and as a result it took only 3 to 4 days for the water to rise to the top of the soil in tubes 8, 9, and 10. The increase in weight observed on these samples as shown by the values plotted is less than that corresponding to their true absorbency but even so, the difference is clearly evident and permits of concluding that an addition of between 4 and 6% binder would represent an optimum value.

In Fig. 5 the progressive rise of the moisture is plotted against time. The dividing line indicating the rise remained recognizable only in tubes 12 and 13 but was less discernible in the other tubes. The absolute absorption in tube 1 amounted to 0.26 gram per in. cm. which means that 1 cu. m. of that soil is capable of taking up 260 kg. water. For tube 8 this value was found to be 0.21 gram per cu. cm., but in this case it is well to recall that prior to starting the test moisture had been added amounting to 0.1 gram per cu. cm. soil so that the total absorption was $0.21 + 0.1 = 0.31$ gram per cu. cm. Expressed in values of the practice it means 310 kg. water per cu. m. From this it can be seen that the volumetric unit of a more densified soil is capable of absorbing more water than that of a soil of lesser density. When as observed in tube 8 the moisture had climbed to the top level, that soil still was not saturated as demonstrated by the fact that after the seventh day its moisture content was $0.247 + 0.1 = 0.347$ gram per cu. cm. or 347 kg. per cu. m. Nevertheless, this soil had not reached its saturation point for it was found that its moisture content kept on rising.

Similar absolute values were found in those portions of the binder treated soils into which moisture had penetrated. Saturation was observed within a few hours on the samples containing a somewhat higher percentage of binder and their respective absolute moisture content within the small penetrated portion was very high. However, the large portion above the sharp dividing line had not absorbed practically any water. It is these samples which represent the mixing proportions most suitable for road construction. The fact that the bottom end of these soil samples, so to speak, were standing in water demonstrated that their capacity to absorb water by capillary activity had practically disappeared.

The following experiment was then made for controlling purposes (Fig. 6): the material susceptible to frost damage was mixed with 6% binder, 25% solids, as shown by tube 12 and transferred into the glass tube.

Another tube was then charged with the untreated material. Upon gelation of the binder, a volume of water corresponding to about one half of the volume of soil in each tube was added through the upper ends of the tubes. At this occasion it was noticed that the water rapidly penetrated into the treated soil and after $1^1/_2$ hr. commenced to flow out of the bore hole of the stopper. After 20 hr. draining, a great deal of water added on the top had passed the tube. The untreated soil showed quite a different behavior. After 24 hr. the soil was fully penetrated and had acquired a mush-like consistency. No water was flowing out of the bore hole thus giving evidence that the water was being held by the capillarity of the untreated material.

These two experiments strikingly demonstrated that the treated soil in contrast to the untreated material behaves like filter sand. Coarse capillaries remain open, the water rapidly penetrates it, but equally rapidly drains away. Such material is not susceptible to being affected by freezing temperatures.

SUMMARY

The experiments have demonstrated the possibility of eliminating the deleterious portion of the capillarity from the soil by means of relatively small additions of a suitable material. The cost of the latter per square meter of road surface appears amply tolerable, particularly when one considers the probable lasting immunization of the treated road portion to frost attacks.

The simplest method of getting the binder into the roadbed would be as follows:

1. Perforating both top and bed using pneumatic chisel.
2. Forcing into the bore hole a strong steel tube, the pointed end of which is perforated.
3. Squeeze the ready made binder into the sublayers of the roadbed by means of suitable pressure equipment. Spacing of the holes to be drilled would have to be governed by the respective absorbency of the soil layers under the roadbed.

Compared with the soil treatment by injecting a cement slurry, the procedure in question has the decided advantage of employing a true solution in contradistinction to the former which uses a highly unstable aqueous suspension. Upon being injected into the ground, the cement slurry rapidly loses its water by the filtering action of the soil which renders difficult its uniform penetration.

Further possibilities of utilizing concentrated spent sulphite liquor for similar purposes are: (1) increasing the load carrying capacity of the roadbed, (2) immobilizing, i.e., preventing the shifting of the soil parties under the junctures of the concrete pavement and (3) as a dust binder on surfaces of unpaved roads.

Translated for the Sulphite Pulp Manufacturers Research League, April 15, 1954, by Hans John.

Condensate Corrosion—Its Causes and Prevention

SELDEN K. ADKINS and MAURICE F. NIELSEN

The effect of condensate corrosion on the steam-condensate system of a paper mill, and the factors causing the corrosion are briefly outlined in relatively nontechnical language. Brief descriptions of the various pretreatment systems and their desirability in minimizing the problem are considered. The desirability of considering all phases of the water treatment for any plant including softening, deaerating, and final chemical treatment is strongly indicated. Many factors must be considered in selection of the various mechanical equipment and the chemical treatments ultimately used, since there are several choices available. Lowered maintenance costs, improvement of operation, and freedom from forced shutdowns, can all be realized when these factors are fully recognized and carefully considered in any plant.

Paper mills, utilizing large quantities of steam for power generation, paper drying, and process heating, are generally designed to reclaim most of the condensed steam and return it to the power plant. Condensate so obtained is essentially distilled water. Containing little or no dissolved solids and some heat, it is excellent feedwater for the power boilers, particularly in the higher pressure units now becoming more common.

A rather elaborate piping system is necessary to collect the condensate and convey it to the power plant. The tremendous area of steel in these lines that is exposed to pure condensate is corroded and creates a potential source of trouble. Iron oxides that result from corrosion of the condensate system, driers, and any equipment where steam is condensed ultimately migrate to the boilers. In the boilers, the corrosion products form deposits, interfere with normal sludge conditioning, contribute to unsatisfactory operation, and, not infrequently, to unscheduled outage of the boilers.

Equally important is the damage done to the condensate system. Unscheduled outage of equipment that causes production losses and frequent replacement of failed piping often results in high cost operation and maintenance.

Considerable data have been published on laboratory studies and field experience dealing with the condensate problem. Two general contributing factors emerge from these reports as the causes of condensate corrosion. These are: (1) dissolved gases and (2) low pH.

These factors are, of course, related. In actual plant practice a mixture of dissolved gases is usually present, some of which cause a low pH value of the condensate.

The main gases which are found dissolved in condensate are oxygen, carbon dioxide, and ammonia. Consideration of the source, characteristics, and effect of each of these gases indicate both the troubles that can be expected and the methods that can be utilized to overcome them.

Carbon dioxide can enter the system and be dissolved in the condensate from a number of sources. Some of the more common ones are: (1) boiler make-up water containing a high concentration of bicarbonate salts; (2) excessively high quantities of make-up water to a boiler system which contains moderately low quantities of bicarbonate salts; (3) use of an improperly selected method of external treatment for boiler feedwater make-up; (4) improper or poor control of any treatment system for boiler feedwater makeup; (5) failure to employ a deaerating heater, degasifier, or both, when composition of the make-up water or make-up percentages indicates that such equipment should be provided.

Bicarbonate salts that are fed to a boiler with the feed-water are broken down at the high boiler water temperatures to liberate carbon dioxide. The carbon dioxide leaves the boiler with the steam and is ultimately dissolved in the condensate. Carbonate compounds also contribute carbon dioxide to the steam and condensate in a similar fashion.

When dissolved in the condensate, the carbon dioxide forms carbonic acid, lowers the pH value of the condensate, and makes the condensate aggressively corrosive to the iron and steel surfaces of the condensate system.

Dissolved oxygen is invariably present in raw water supplies normally used for makeup. Unless hot process methods that include deaeration are employed, relatively large quantities of this gas will be liberated in the boiler, conveyed with the steam, and ultimately dissolved in the condensate. Either carbon dioxide or oxygen, singly, cause appreciable corrosion of the condensate lines. When both are present, the rate of attack is appreciably greater.

By itself, oxygen does not alter the pH of the condensate. The fundamental reactions involved in oxygen corrosion are complex and beyond the scope of this discussion. All are familiar, however, with the formation of rust on iron when both water and air are present. The reaction in a condensate line is exactly parallel and is usually accelerated due to the higher temperature.

Ammonia is a strange, dual-personality gas. Many consultants and operators have successfully applied ammonia to increase the pH of condensate and minimize corrosion of iron and steel. When copper and copper alloys are not utilized in any portion of the system, this is one possible approach. However, it is indeed rare to find a system without copper and copper alloys. Because ammonia has an extremely high vapor pressure and does not readily dissolve in initially formed condensate, it tends to concentrate in certain portions of the system. As these portions of the system contain copper or copper alloy tubes, valves, or other equipment, the resulting corrosion is equally as annoying and expensive as the corrosion of the iron and steel portions. It is apparent, therefore, that some of its characteristics

Selden K. Adkins and Maurice F. Nielsen, Technical Service Dept., National Aluminate Corp., Chicago, Ill.

place it in the "culprit" class with carbon dioxide and oxygen. These are the main offenders. Failure to recognize, remove, or neutralize them invariably results in a severe corrosion problem.

Fortunately, a large volume of research and development work has been done to find methods of protecting condensate return lines so that today the main problem for plant operators is to decide what method will provide the best and most economical protection for their particular installation. The correct decision will be dependent upon factors such as the percentage of make-up water required in the boiler operation, the composition of the make-up water available, and the capabilities of the pretreatment system selected.

Let us first consider the various methods of chemical pretreatment that can greatly reduce the intensity of the problem. Where the raw water supply available, the amount of makeup required, and the type and pressure of boilers involved all indicate a need for external softening, several systems should be carefully studied and evaluated. Types of systems presently available, which can greatly reduce all three of the dissolved gases mentioned, when properly selected for the raw water supply available, carefully designed for the quantities necessary, and religiously operated with careful control are: (1) hot lime-soda-aluminate; (2) hot lime-soda-aluminate, phosphate; and (3) hot lime-aluminate, hot zeolite.

Oxygen removal in these systems is based on incorporation of a deaerating system or section. When ammonia is present in the raw water, it is usually desirable to chlorinate the raw water previous to introduction into the softener to facilitate its reduction in the equipment. It cannot be overemphasized that final selection must be based on all of the factors existing at the particular plant.

Systems that operate "cold" and which can reduce or, in some cases, nearly eliminate carbon dioxide are as follows: (1) sodium zeolite, followed by acidification, degasification, and neutralization; (2) acid zeolite, followed by degasification and neutralization; (3) "split-stream" combination of sodium and acid zeolites, followed by degasification; (4) sodium zeolite–chloride anion, more commonly known as "de-alkalization"; and (5) demineralization, utilizing acid regenerated cation exchanger and caustic regenerated, strongly basic anion exchanger with degasifier between them.

None of the methods listed remove any oxygen from the water. In some instances, where air stream degasification is used, additional oxygen is added, often to the point of saturation. Some ammonia removal is effected in the systems employing acid regenerated cation units. Demineralization is very effective in many plants. Again, all factors must be carefully considered and evaluated before final selection is made.

It is evident that the use of any one of the systems mentioned above does not completely eliminate all three of the gases which are being considered. Residual carbon dioxide, oxygen, ammonia, or a mixture of two or three of these remains in the make-up water. It is usually wise, therefore, to give careful consideration to a deaerating heater. Deaerating heaters remove oxygen to very low residuals. Some of the bicarbonates, which may enter the deaerator from some of the systems, are partially broken down in the deaerating heater and some carbon dioxide additionally removed. In most paper mills low pressure, exhaust steam is available for the successful operation of the deaerator. When properly selected and operated, a deaerator can greatly assist in minimizing the entire condensate corrosion problem.

Assuming that all practical mechanical methods have been incorporated into the system, residual corrosive gases will still be present in sufficient quantities to cause corrosion. The last defense, and probably the most important, against condensate corrosion is a carefully controlled chemical treatment program. With traces of oxygen present in feedwater, even when passed through a deaerating heater, the use of a catalyzed sodium sulphite is advisable. In the low quantities usually demanded, this material offers an economical and easily applied method of removing the last possible traces. Application well ahead of the boilers assures freedom from oxygen in the steam and in the condensate.

Although several materials are available for the final step in the protective program, the plant operator is usually at liberty to select one of two basic methods. These two methods are: (1) use of volatile, neutralizing amines or (2) use of film-forming or "barrier" compounds.

In plants where boiler water make-up requirements are low and where the carbon dioxide content of the steam is not excessive, the volatile, neutralizing type of amine condensate corrosion treatment is usually most suitable. In selection of this material, care should be taken that it is not corrosive to any of the metals in the system, such as copper and copper alloys, and that the material is stable under the conditions of temperature and pressure encountered. These amines are a class of volatile, organic, alkaline chemicals. Of the wide family of amines that have been studied and used, a stabilized morpholine has been found very effective in condensate corrosion prevention. This material has the desirable characteristics that make it possible to add it either to the boiler water or to the steam lines. Having a low vapor pressure, it condenses rapidly, along with the steam, immediately increasing the pH of the entire system, neutralizing the carbon dioxide, and eliminating active corrosion. The chemical is returned with the condensate to the boiler and again volatilized with the steam and continuously recycled throughout the system. The only losses are those occasioned by steam losses through process use, water losses through blowdown from the boiler, and a small amount through the deaerator vent if a deaerator is employed.

The volatile amine-type treatment is available in liquid form and can be continuously introduced into the system by several mechanical means. It can be fed directly into the boiler or steam lines by means of a small, positive displacement, reciprocating chemical feed pump; directly into the steam line by use of a condenser-type feeder; or continuously into the boiler feed pump section by controlled drip feed. Properly installed and operated, any of these methods is acceptable provided a continuous, controlled feed of the material is assured. Depending on the amount of

carbon dioxide present in the steam, relatively low quantities of this material are necessary to maintain a pH of 8.5 to 8.8 throughout the entire steam-condensate system. Years of field experience indicate that maintaining pH values in this range eliminates condensate corrosion from carbon dioxide entirely.

A fact not usually recognized is the "solution" pressure on iron exhibited by gas-free pure water of low or "neutral" pH. . It has been demonstrated that iron will dissolve in such water until equilibrium is established at a pH value of approximately 9.2. This, then, makes even more attractive the use of the proper volatile amine to minimize condensate line corrosion.

In plants where make-up requirements are high, a more economical form of treatment is obtained through the use of film-forming chemicals. The materials used for this purpose are usually high molecular weight organic chemicals that have the property of being carried by the steam and forming an adherent film on the steam and condensate lines. These materials are usually not truly volatile and should be fed directly into the steam lines. The film so formed prevents corrosion because it does not permit the condensate, containing carbon dioxide and oxygen, to come into contact with the metal. Selection of a film-forming type of treatment dictates that careful consideration of all of the equipment present be made if the program is to be successful. Since a true film-forming material is insoluble and nonvolatile, a portion of the chemical will be returned to the boiler with the condensate. It is essential, therefore, that the material chosen does not have any harmful effects on the regular boiler treatment chemical program. Feed of a true film-forming material that is "hydrophobic" ahead of steam turbines, especially where superheat conditions exist, is undesirable. If the material has any desirable characteristics for forming a stable, uniform film, turbine deposits are bound to result.

In applying a film-forming material, the program is usually initiated with a relatively high dosage of the chemical in order to form an initial film. After this initial "charge" has been made, dosage is adjusted in accordance with the concentrations of oxygen and carbon dioxide present in the condensate and the physical size of the system so that a continuous film will be maintained in all parts. Being insoluble, these materials deny the possibility of quantitative chemical analysis, so it is imperative that "by-pass" test nipple installations be made for observing the effectiveness of the application. These test nipple installations can generally be made on small, easily accessible condensate lines, as near the terminal end of the line as possible, with relatively low expense.

Certain general precautions must also be observed whenever film-forming treatment chemicals for condensate line corrosion prevention are used. These are:

1. The chemical selected must be stable under the conditions of pressure and temperature existing.
2. The material should not be fed into steam containing excessive superheat that will definitely have an adverse effect on the film-forming properties.
3. The dosage must be carefully controlled to make certain that the film is thin, continuous, and present in every part of the condensate return system. It is essential that the film formed be maintained as thin as practicable so that heat transfer in condensers and other similar equipment will not be materially affected.

In summary, it is immediately apparent that many varied factors enter into the condensate corrosion problem and that several choices of pretreatment systems, chemical treatment programs, and mechanical equipment are open to plant operators. The extensive condensate return line systems that nearly every paper mill has, can and are today being protected by use of the known facts. Substantial savings are possible under a good corrosion protection system. Since each plant can, and usually does, present a different set of circumstances that affect this problem, a reliable water treatment consultant should be engaged. An experienced organization will be able to recommend and supervise a program of corrosion protection treatment that will reduce maintenance costs and reduce down time of important manufacturing equipment.

Received Feb. 26, 1954. Presented at the 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 18–21, 1954.

The Use of Isolated Soybean Protein in Paper Coatings

H. R. HALL

Depending on the severity of its chemical treatment, isolated soybean protein is said to be modified or unmodified. A flow sheet is presented showing how the unmodified protein is subjected to milder processing. When coating colors are made with the two proteins, certain differences are found, principally in viscosity, which are explained by the presence of cystine in the unmodified protein. However, the addition of a reducing agent, sodium sulphite, to the unmodified protein gives it properties similar to the modified protein. Machine coating colors made with the unmodified protein are dilatant when tested with the Hercules high shear viscometer. Viscosity curves show how a second additive overcomes this tendency. Papers coated with these two proteins in the color have equal brightness and finish, but the unmodified protein has a slightly lower wax pick. Finally, the unmodified protein is cheaper, but may require special formulas and techniques to produce results comparable to the modified protein.

There are two types of isolated soybean protein available to the paper coater. One type has been used in coating mills for several years, while the other has been in production only a short time. Although these two types have many common characteristics, they cannot be used interchangeably in coating formulations. This paper will show the major differences that have become evident between two commercial brands used in coating trials and experiments and will offer an ex-

H. R. Hall, Assistant Technical Director, Allied Paper Mills, Kalamazoo, Mich.

planation for some of the differences. Since the variation begins at the manufacturer's plant, the production process will be considered first.

The raw material for isolated protein is soybean flakes or meal containing 44% (*1*) protein, 34% carbohydrates, 12½% moisture, and ½% oil from the solvent extraction process. The meal (Fig. 1) is mixed with water and dissolved in alkali, such as caustic. The residue is separated by screening and centrifuging and the protein is precipitated by an acid, such as sulphuric acid. The protein curds after centrifuging, filtering, drying, and grinding are ready to be marketed. This

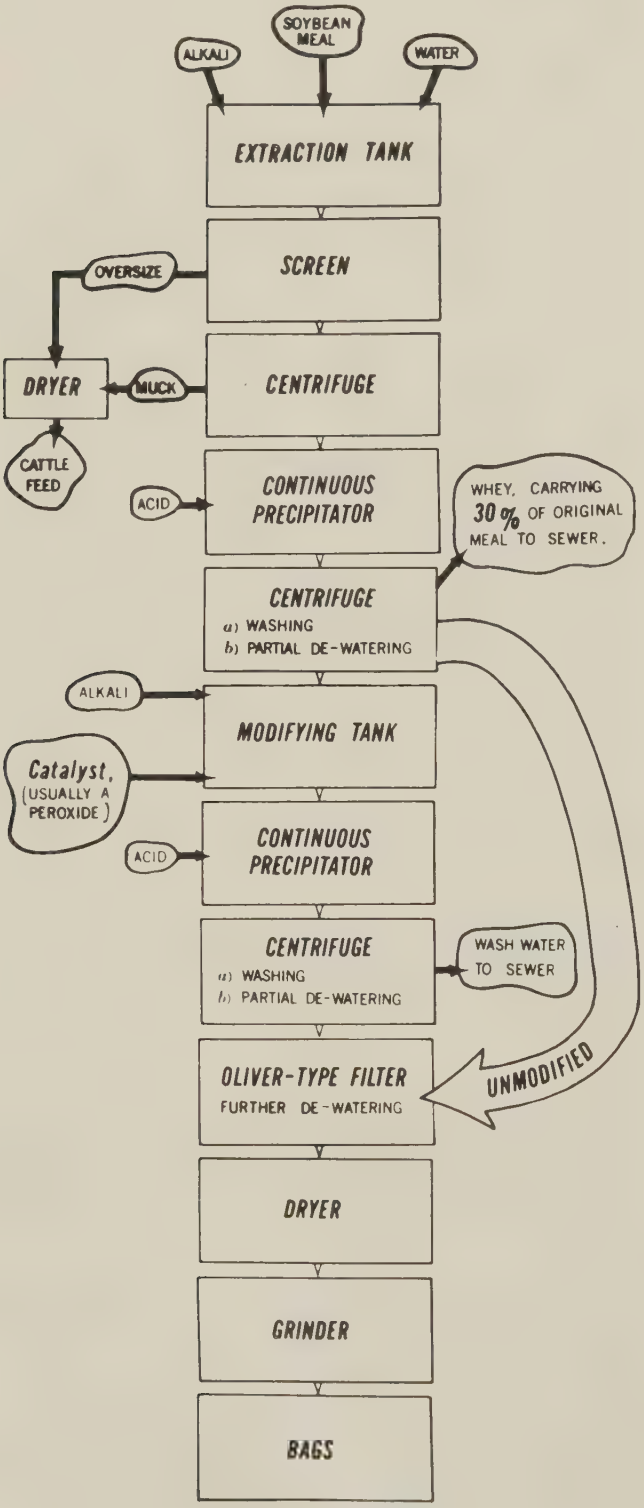

Fig. 1. Flowsheet for isolated protein

Table I. Comparison of Viscosity of Modified and Unmodified Proteins

(A) 60 g. modified protein 360 g. water 12 ml. 28° ammonia 4 ml. 50% caustic Stormer viscosity, 41 cp. at 72° F.	(B) 60 g. unmodified protein 360 g. water 12 ml. 28° ammonia 4 ml. 50% caustic Stormer viscosity, 225 cp. at 72°F.
(C) Same as above with: 0.9 g. Na_2SO_3 Stormer viscosity, 40 cp. at 72° F.	(D) Same as above with: 0.9 g. Na_2SO_3 Stormer viscosity, 43 cp. at 72°F.
After heating to 127°F. and cooling to 76°F. in 40 hr. the Stormer viscosity was:	
(A) 39 cp.	(B) 358 cp.
(C) 39 cp.	(D) 146 cp.

mild chemical treatment both in the solvent extraction process and in the isolating process produces a protein which will be referred to as an unhydrolyzed or unmodified protein.

The process for the modified or hydrolyzed protein includes a second dissolution with alkali and heat. As outlined by Burnett and Eichenberger (*2*), the precipitated protein is redissolved in alkali and digested at a high pH for several hours. According to Julian and Malter (*3*), the redissolved protein should be treated with sodium peroxide to improve color, adhesion, and viscosity. The protein is reprecipitated and again centrifuged. This product is ready for the market after filtering, drying, and grinding to about 40 mesh. These two methods of manufacture produce isolated proteins of different characteristics when used in coatings.

One of the most obvious differences between the proteins is in viscosity (Table I). The unmodified protein is much more viscous than the modified protein until a reducing agent is added. If the dissolution of the protein is carried out at room temperature, the resulting viscosities are practically equal. It is believed that the explanation for this may be found in the amino acid residues that comprise the soybean protein molecules. Of the eighteen amino acid residues listed by Markley (*4*), soybean protein contains about 0.7% (*5*) cystine $HOOC \cdot CH(NH_2) \cdot CH_2 \cdot S \cdot S \cdot CH_2 \cdot CH(NH_2) \cdot COOH$. The disulphide linkage (S—S) must exist in the unmodified protein or must form when the protein is dissolved in alkali to bind molecules together (Fig. 2) and

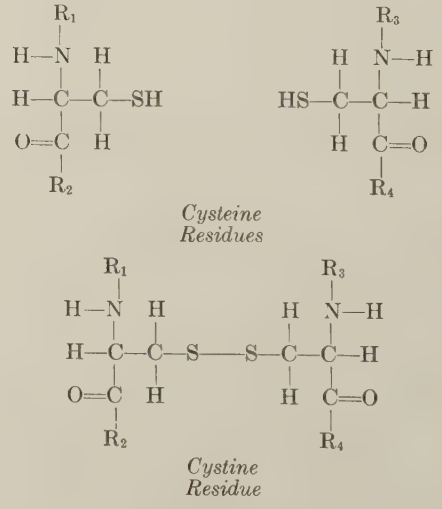

Fig. 2. Cystine reduced to cysteine

produce a high viscosity. The reducing agent (sodium sulphite) presumably breaks the intermolecular link and forms a cysteine residue. In the case of the modified protein, it is believed that the chemical digestion step in its manufacture prevents this reaction by forming cysteic acid (*6*).

A second obvious difference between the proteins is in the color of their solutions. The modified protein when cut with caustic is lighter, being tan or greenish tan while the unmodified protein is dark brown or very dark brown. However, when the proteins are used in coatings, the brightness of the resultant sheets is essentially equal. The dark coloring matter in the unmodified protein becomes light yellow when the pH falls below $8^1/_2$, which happens when the color is coated on an acid sheet.

A third difference may be found in the mixing procedure. The modified protein can be mixed in either a Z bar mixer starting with dry clay and a protein slurry, or the protein and clay can be made up separately. The latter is preferred with the unmodified protein since prolonged, doughlike mixing produces a thick coating. This thickening is believed to be a reforming of disulphide linkages.

The following experiment shows a comparison between coatings containing (1) modified protein, (2) unmodified protein, and (3) unmodified protein plus a reducing agent. Sixty grams of protein were dispersed in 360 grams of water and allowed to soak 15 min. Then ammonia was added (12 ml. of 28° Bé.) and caustic was added in varying amounts on the weight of the protein, i.e., 3, 4, 5, 6, and 7%. A clay slip at 60% solids was made of no. 1 coating grade clay and $^1/_2$% tetrasodium pyrophosphate. The protein size was stirred into the clay and a 12 to 13-lb. brushout was made with the R & D coating rods.

The results are shown in Table II. The color viscosities followed the general pattern of the protein sizes with the reducing agent having a pronounced effect upon the unmodified protein. Also the caustic produced a maximum viscosity of the unmodified protein color at 5%. The same did not hold for the other two

Table II. Comparison of Coating Colors

Per cent caustic on protein	*Stormer viscosity of color, cp.*	*Wax after calendering*	*Brightness, G.E.*	*Per cent finish, Ingersol*
	A. Modified Protein			
3	43	9.4	73	62
4	45	9.6	74	64
5	43	8.9	73	69
6	40	9.9	73.5	64
7	48	9.8	74	67
		Av. 9.5	73.5	65
	B. Unmodified Protein			
3	26	8.9	72.5	62
4	147	7.9	74	62
5	886	8.9	72	64
6	269	9.8	74	62
7	112	9.9	74	64
		Av. 9.5	73.3	63
	C. Unmodified Protein Plus Reducing Agent			
3	32	7.9	73.5	64
4	32	8.1	73.5	67
5	32	8.8	73.5	64
6	40	8.8	73.5	69
7	40	8.9	72.5	67
		Av. 8.8	73.3	66

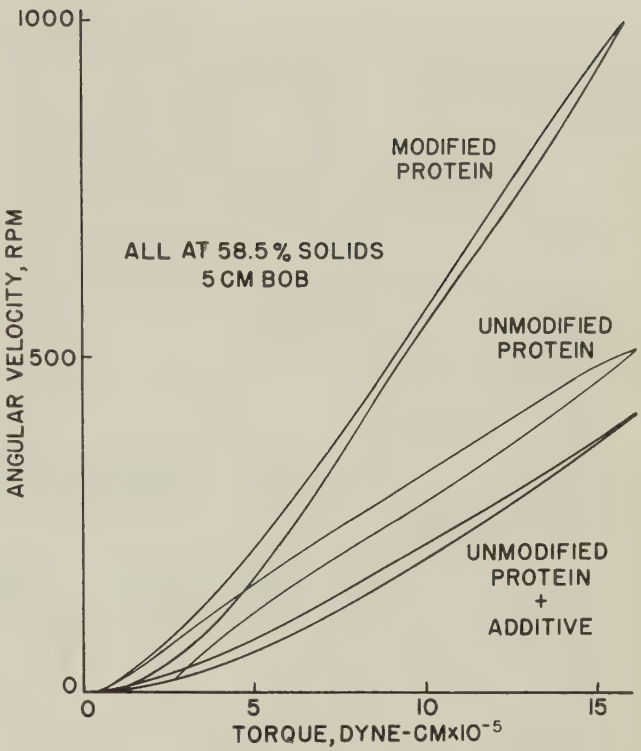

Fig. 3. Hercules high-shear viscosity

colors, but it is believed that there is some correlation between this peak viscosity and the wax which reached a maximum for all colors between 5 and 6% caustic. Similarly, Gotthoffer (*7*), using a modified protein, reported a maximum wax with 5% caustic on the weight of protein while Bain et al. (*8*) reached 6%. The brightness was essentially the same for all samples while the finish was slightly less for the unmodified protein without the reducing agent.

A fourth difference between modified and unmodified proteins becomes evident in making machine coating colors. The unmodified protein requires special attention. A formula was tried using trisodium phosphate, ammonia, and some sodium silicate as dissolving agents. This gave a very free flowing color at low shear and intermittent trial batches ran successfully on the machine coater. However, in later continuous runs, the coat weight rose abnormally and the coating had to be diluted beyond the capacity of the drying system. The Hercules high shear viscometer (*9*) was used in defining the problem and affecting a cure. Viscosity tests revealed that the coating was dilatant (Fig. 3). Also some pattern such as reported by Smith, Trelfa, and Ware (*10*) was noted at high coat weights. Many cutting agents and additives were tried in an effort to make the coating less dilatant and, therefore, operable on the machine coater. Eventually it was found that sodium stearate produced a thixotropic psuedoplastic coating which performed well on the machine coater. In contrast to the time and effort spent in finding a satisfactory formulation for the unmodified protein, the modified protein produced an operable coating with no special additives.

Finally, the unmodified protein can be expected to be cheaper than the modified protein because of the fewer steps in the process and the less drastic chemical treatment. It has been shown that similar results can be obtained with both types of isolated soybean protein

on the brush coater or on the machine coater. However, if the coating superintendent desires to use unmodified protein, he may find it necessary to develop special formulas and techniques to fit his equipment.

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PRESENTED at the Fifth Coating Conference of the Technical Association of the Pulp and Paper Industry, Poland Spring, Me., May 24–26, 1954.

The guidance and help of Glenn Davidson were invaluable in developing the theory and in providing the flow sheet (Fig. 1) presented herein.

Evaluation of the TAPPI-SFMC Drainage Time Tester for Mill Control of Insulating Board Pulps

W. H. GRAHAM

This report is an examination of the functioning of the TAPPI-SFMC drainage time tester of TAPPI Suggested Method T 1002 sm-51 in the control of pulps in an insulating board mill. The drainage time tester is considered from the standpoint of its accuracy of results, reproducibility of results, speed and simplicity of operation, its ability to show differentiation of pulps, and its ruggedness. The report presents a short statistical analysis discussing the average and variations of drainage time obtained by four mill control men sampling the same pulp. The data are presented in the form of charts. The report also gives the design of a graphic aid which may be used to convert drainage time results to a standard dry pad weight basis.

THIS report is a critical examination of the functioning of the TAPPI-SFMC drainage time tester of TAPPI Suggested Method T 1002 sm-51 for the control of pulps in an insulating board mill. A TAPPI-SFMC drainage time tester has been in use at the Johns-Manville Products Corp., Natchez, Miss., mill since Dec., 1952.

EQUIPMENT EVALUATION

In selecting any piece of equipment for mill control work there are some six points that should be considered These points are: (1) accuracy of test results obtained, (2) reproducibility of results between operators, (3) speed of operation, (4) simplicity of operation, (5) ability to differentiate between pulps, and (6) maintenance problems.

Evaluating the TAPPI-SFMC drainage time tester for these six points the following are found:

Accuracy of Test Results Obtained

Fifty drainage tests were run on a sample of groundwood pine pulp by the same operator. Figure 1 shows the frequency histogram for these 50 tests in bar chart form. Superimposed over the frequency histogram is the theoretical normal curve expected for 50 tests showing this amount of variation. It may be noted the theoretical distribution is a fairly close fit to the actual test distribution. Therefore, it may be assumed the drainage time of this pulp had a fairly normal distribution. Considering the accuracy of the average ($\bar{X}$) drainage time computed from these 50 tests it may be shown 53.7 sec. is within ±0.8 sec. of true average of the parent population of pulp from which this sample was selected. The author is not attempting to confuse anyone by throwing in a little statistics here but it appears to be the best way to show his point. Actually, all the plus or minus accuracy figure means is that if repeated tests should be made on the same tank of pulp averaging 50 tests each time, the average of each set of 50 tests should not be over 0.8 sec. either side of the 53.7 sec. average found in the original check.

Referring to the frequency histogram in Fig. 1 it might be said, "I don't care how accurate you say the average of 50 tests may be, the chart shows that you obtained drainage times varying from 50 to 57 sec. That is over 10% variation. Do you call that accu-

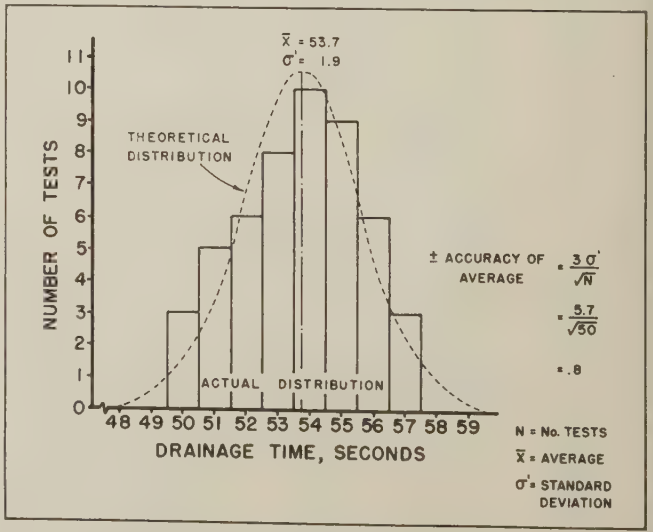

$\bar{X}$ = 53.7
σ' = 1.9
THEORETICAL DISTRIBUTION
ACTUAL DISTRIBUTION
NUMBER OF TESTS
0 1 2 3 4 5 6 7 8 9 10 11
48 49 50 51 52 53 54 55 56 57 58 59
DRAINAGE TIME, SECONDS
± ACCURACY OF AVERAGE = 3σ'/√N
= 5.7/√50
= .8
N = No. TESTS
$\bar{X}$ = AVERAGE
σ' = STANDARD DEVIATION

Fig. 1. Frequency histogram of 50 drainage time tests made on one sample of pulp

W. H. GRAHAM, Quality Control Supervisor, Johns-Manville Products Corp., Natchez, Miss.

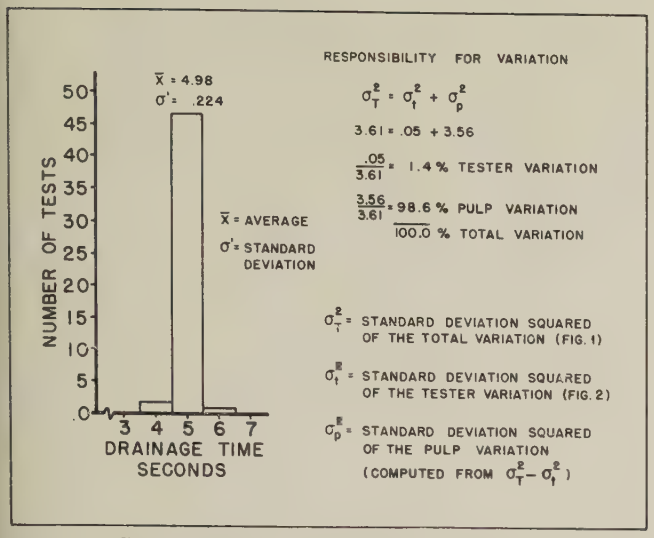

RESPONSIBILITY FOR VARIATION
$\bar{X}$ = 4.98
σ' = .224
$\sigma_T^2 = \sigma_t^2 + \sigma_p^2$
3.61 = .05 + 3.56
.05/3.61 = 1.4% TESTER VARIATION
3.56/3.61 = 98.6% PULP VARIATION
100.0 % TOTAL VARIATION
$\bar{X}$ = AVERAGE
σ' = STANDARD DEVIATION
NUMBER OF TESTS
DRAINAGE TIME SECONDS
σ_T^2 = STANDARD DEVIATION SQUARED OF THE TOTAL VARIATION (FIG. 1)
σ_t^2 = STANDARD DEVIATION SQUARED OF THE TESTER VARIATION (FIG. 2)
σ_p^2 = STANDARD DEVIATION SQUARED OF THE PULP VARIATION (COMPUTED FROM $\sigma_T^2 - \sigma_t^2$)

Fig. 2. Computation of responsibility for variation. Frequency histogram of 50 drainage time tests made on the 28-mesh screen fraction of the basic pulp used in Fig. 1

racy?" The answer would be, "Yes, that is an accurate report of the actual variability of drainage time for that particular tank of pulp." There are variations of drainage time within the same tank of pulp just as there are variations in all things. Sometimes we are a little startled when these variations are portrayed for us. In our own operations we have made one single drainage time check on a sample of pulp and said, "This is it," when we might have been any place between the top and bottom of our variation range for pulp. It is not the purpose to discuss reduction of variables at this time or even to discuss how many tests should be averaged for a given limit of accuracy; that is something for the Statistical Committee. The author's purpose is to evaluate the accuracy of the TAPPI-SFMC drainage time tester.

Since all pulps have variation within a given sample it was decided to take some of the basic groundwood pine pulp under consideration and screen out one fraction of the component fibers. The drainage time of this fraction should have only a minimum of variables. The fraction remaining on a 28-mesh screen in a Bauer-McNett classifier was selected for the test. Figure 2 shows the frequency histogram for 50 drainage time tests run on the same drainage pad sample from the 28-mesh fraction of the basic pulp. It may be noted the variation in drainage time for this selected stock is only ±1 sec. with 47 of the tests being clocked at 5 sec. The average drainage time computes out to be 4.98 sec. and the standard deviation (a measure of variation) is 0.22 sec. This may be termed the variation due to the testing equipment.

The total variation in drainage time found in the original 50 tests shown on Fig. 1 is made up of testing variation and of pulp variation. A simple analysis of variance (standard deviation squared) making use of the relationship: standard deviation squared of the total variation, is equal to the standard deviation squared of the testing variation plus the standard deviation squared of the pulp variation. The equation is $\sigma^2_{total} = \sigma^2_{testing} + \sigma^2_{pulp}$. In this way can be shown the per cent of the variation for which the testing equipment is responsible. The relationship of these variances is illustrated to the right in Fig. 2. It may be stated of the total variation encountered, approximately 1.5% of it is due to the testing equipment and that 98.5% of it is due to pulp variation. Therefore, it is believed the accuracy of the TAPPI-SFMC drainage time tester is sufficient.

Reproducibility of Results Between Operators

The second point to be considered when selecting control equipment is, "Will different operators get the same answer when using the tester on the same basic stock?"

In order to check this point four different operators ran 15 drainage time checks on the same large sample of pulp. The results of these checks are shown in Fig. 3.

It may be noted all four operators obtained approximately the same average drainage time for the 15 tests. The range in drainage time for all operators was 4 sec. Operators A, B, and C were trained operators who use the drainage time tester regularly while operator D has used the tester infrequently.

Computing the accuracy of the average of 15 tests on this stock, which was from the same sample as discussed in Fig. 1, it may be shown that an average of 15 tests would have to be more than 1.5 sec. either side of the 53.7 sec. average found for the 50 tests, to indicate that there was a significant difference in the drainage time. The averages obtained by these four operators are well within the range. Therefore, it is a valid assumption to say different operators should be able to get the same answer when using the TAPPI-SFMC drainage time tester on the same stock.

Speed of Operation

For most mill control work it is not possible to wait all day for the data; the information is required quickly so that you will know whether or not a process adjustment is required. The TAPPI-SFMC drainage time tester does meet the speed requirement on the pulp used in our mill. We use the "hand squeeze" method of dewatering the sample for test and shoot for a 10.6-gram dry pad weight. In collecting the data on the 50 drainage time tests, used for Fig. 1 of this report, only a little over 2 hr. elapsed time was required. We have used the tester for drainage time control on six Bauer refiners operating at the same time and have been able

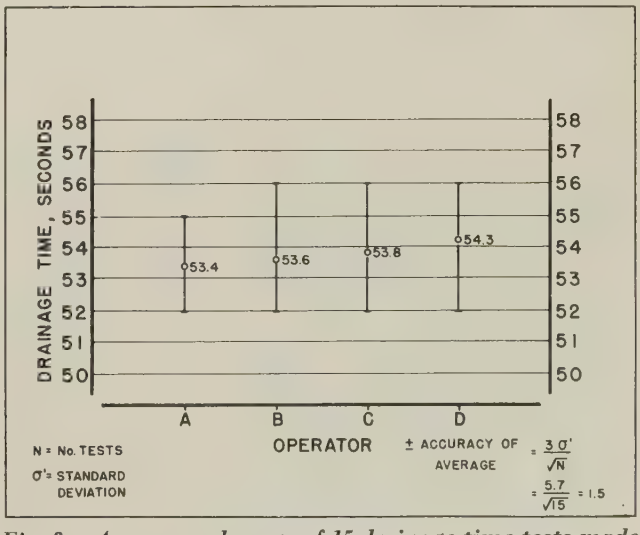


Fig. 3. Average and range of 15 drainage time tests made by each of four operators

to make the complete circuit of all Bauers in 20 min. There is no question on the speed of operation of the TAPPI-SFMC drainage time tester, it is more than satisfactory in speed of operation.

Simplicity of Operation

Simplicity of operation is essential in mill control work. In most mills the control men operating the drainage time tester would not have over a high school education. Usually, these men are hired locally and have had some training either on the job or through the company training program. They are not trained laboratory technicians and should not be confronted with some complex piece of testing equipment or method of test.

The operation of the TAPPI-SFMC drainage time tester is quite simple. The control man collects his pulp sample for test, dewaters it with a hand squeeze, and weighs up a predetermined amount of the dewatered pulp that will give a standard dry pad weight. The wet pulp weight used must be worked out with each control man and will be dependent upon how hard he can squeeze. He then breaks up this specimen in a beaker of water or the tester cylinder, fills the cylinder to the top marker, agitates the mixture thoroughly, opens the valve and starts the stop watch simultaneously. He stops the watch when the water level passes the lower marker on the cylinder. The elapsed time between the two markers is the drainage time for that test. What could be more simple? There is a well-defined start point and end point for the test and the preparations are not complex.

We are able to train a control man how to operate the tester in about a half day of routine testing. We usually observe his operations for another day or so to make sure that our training has been adequate. We have very little retraining to do in the operation of the tester.

There are some refinements that can be applied to the test results. These will be discussed later, but the essentials of the operation of the TAPPI-SFMC tester fulfill the requirement for simplicity.

Ability to Differentiate Between Pulps

In mills using a blend of pulps the ability to differentiate between pulps becomes an important item in mill control work. If it is desired to control the drainage time of the various pulps the tester must be versatile enough to give accurate drainage times throughout the entire range of pulps used. In our mill we use blends of groundwood pulp and semichemical pulp. Figure 4 shows typical frequency distributions of drainage times obtained on three different pulps. It is believed that it is quite apparent that the TAPPI-SFMC drainage time tester does have the required versatility for differentiation between pulps.

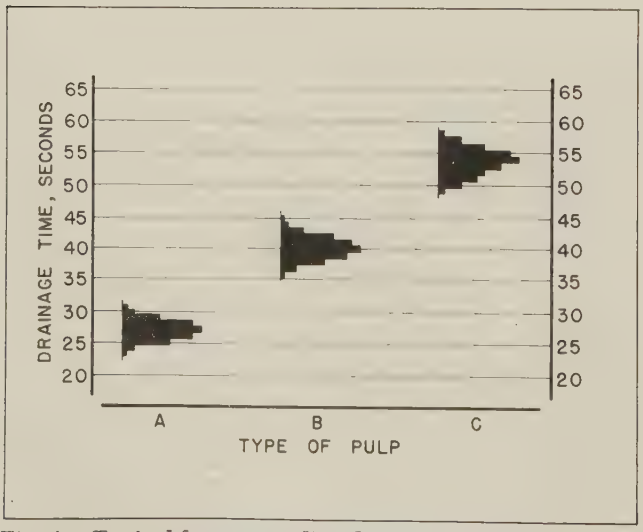


Fig. 4. Typical frequency distributions of drainage time obtained on three different pulps

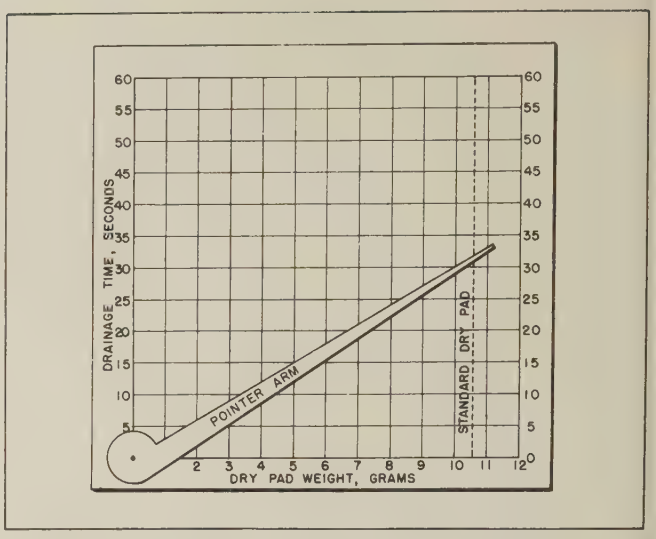


Fig. 5. A graphic aid used to convert drainage time results to a standard dry pad weight basis

Maintenance Problems

The maintenance cost on our TAPPI-SFMC drainage time tester has been extremely low. The only repairs in over a year of daily operation have been the replacement of one screen, two gaskets, and to tighten the valve release linkage.

The replacement of the screen was our own fault. Since the stirring rod was shortened so the control man's fingers hit the top of the tester before the bottom of the rod hits the screen, no screen replacements have been required.

To clean the plastic cylinder whenever it becomes dirty it is swabbed out with a cloth which has been dipped in solvent. From a maintenance standpoint better performance from any piece of test equipment could not be desired.

COMMENTS

From a usage standpoint, handles could be put on the bottom collar of the adapter sleeve which would facilitate application or removal of the tube when making a test. Also, the set screws in the dump valve linkage collar could be made heavier so that they would hold better. This would eliminate slackness in the linkage through continued use and the possible error of the valve being opened different amounts.

As a critical examination of the TAPPI-SFMC drainage time tester this report has been favorable. Frankly, we like it for drainage time control work. It is a self-contained unit having excellent accuracy, versatility, speed, simplicity, and requires practically no maintenance. We believe that it does the job for which it was designed.

Earlier in this report is was mentioned there were

some refinements which could be applied to the test results. One of these is to convert all drainage times to a standard dry pad weight basis. Naturally the control men do not hit the standard dry pad weight every time. This might be considered a disadvantage of the TAPPI-SFMC drainage time tester but for normal mill control work the dry pad weights are usually close enough to the standard weight and no correction is necessary. Our control men are required to record both drainage time and dry pad weights for strategic control points. Thus, if the production foreman sees an unusually low drainage time which has a low dry pad weight, he can correct this test by converting it to the standard dry pad weight basis.

David Haig from the Johns-Manville Research Center in Manville, N. J., has made a study of the effect of dry pad weight on drainage time. As a result of his findings a graphic aid has been devised which may be used to convert the drainage time results to a standard dry pad weight basis. Figure 5 shows the basic design of this graphic aid. Its use is fairly simple; the pointer arm is aligned across the coordinates of drainage time and dry pad weight for the particular test. Then go up or down along the pointer arm to the standard dry pad weight coordinate and read off the corresponding standard drainage time coordinate.

At the present time one of these graphic aids is mounted on the bulletin board alongside the master control record. The production foreman uses it to convert any questionable drainage time reported by the control man to a standard dry pad weight basis. The control man could make this conversion prior to recording the drainage time on the master control record, but we prefer the psychological effect of having the foreman make his own conversion; then we know he is looking at the control record.

Received Nov. 18, 1953. Presented at the 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 15–18, 1954.

The Use of Peabody Scrubbers on Lime Kiln Stack Gases

P. C. MOCKRIDGE

The problem of collecting dust from lime kiln stacks is discussed and the inherent advantages of a high efficiency scrubber shown. The Peabody scrubber has been installed at a number of mills, and a typical unit is described including specific information as to efficiency, size, pressure drop, and operating principle.

Many pulp mills operating rotary lime kilns today recognize that the venting of these gases up a stack without effective dust collection, creates an unnecessary dust nuisance around the plant and results in needless loss of lime and heat. In the search for suitable dust collection equipment, many devices may be considered, including dry and wet types.

The simplest device, the dry cyclone, will ordinarily be unsuited for use alone because there is a considerable quantity of fine material below 10 mu in size in the kiln gases which will pass through the cyclone and create an objectionable stack. Tests run by this company indicate that the fines not collected by cyclones may run from 2 grains per standard 60°F. cu. ft. to 3 or 4 grains, depending upon type of kiln, type of cyclone, and operating conditions.

Bag-type collectors are at a disadvantage because of the relatively high moisture content and temperature of the gases, while electrostatic collectors would involve a very high capital expenditure.

On the other hand, an efficient wet scrubber has certain inherent advantages and is well suited for dust collection from kiln gases. The collected dust is recovered as a warm dilute slurry well suited for washing the filters and thickeners, and the recovered dust is thus caught without additional dewatering equipment. Heat is also recovered since the scrubbing water is warmed by the stack gases. A further advantage in wet collection in the elimination of dry handling of collected solids with its associated dust problem.

Paul C. Mockridge, Chemical Engineer, Scrubber Division, Peabody Engineering Corp., New York, N. Y.

A number of Peabody scrubbers are now in service on rotary lime reburning kilns installed at Weyerhaeuser in Everett and Longview, West Virginia Pulp & Paper at Covington, and the Chesapeake Corp. at West Point, and a number of other units are on order or soon to go into operation. A typical Peabody unit for this service is shown in Fig. 2 and for a 10-ton per hr. kiln, the scrubber would be approximately 10 ft. diameter by 22 ft. over-all in height. The unit contains a spray slot stage, impingement baffle plate final cleaning stage, and an entrainment separation stage. The scrubber is fabricated of $^1/_4$-in. steel plate, except for the active elements of the impingement plate and entrainment separators which are of 18–8 stainless steel construction.

The flow of gas and water may be described as follows: hot gas from the feed end of the kiln enters a plenum chamber and then passes into the gas inlet located in the base of the scrubber. (In some installations the Peabody unit is preceded by a primary spray scrubber which serves as a plenum chamber and pebble feed, but has no effect on the Peabody performance.) The gases then rise through a spray zone created by a num-

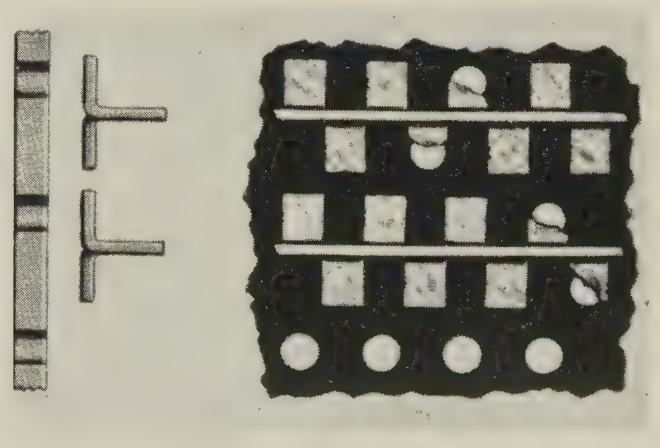


Fig. 1. Plan and section of impingement plate

ber of medium size, low pressure, nonclogging-type nozzles, and become saturated with water and stripped of the coarser dust in preparation for the intensive cleaning action produced on the upper stages. The first of these cleaning stages is called a spray aspirating slot stage and consists of a number of rectangular openings approximately 1 in. wide by 3 ft. long in a diaphragm forming a floor in the scrubber. A rectangular chimney is set about $^1/_2$ in. above these openings forming a slot through which water is aspirated by the flow of gas through the diaphragm. Gas and water become thoroughly mixed in the chimney thus wetting and agglomerating the dust particles in preparation for the final cleaning by the impingement plate stage above. Thorough flushing of this stage is obtained by the water spray thrown from the slot stage thereby avoiding the sticking of any dust particles on the plate underside.

The partially cleaned gases then enter the impingement plate stage which consists of an assembly of a perforated sheet with 600 holes per sq. ft. covered by an impingement baffle grid framework mounted in such a manner as to place an individual baffle directly over each perforation at the point of maximum jet velocity. Figure 1 shows the assembly in plan and section.

A brief explanation of the impingement plate action follows: gas flows through the perforated sheet and is broken up into many thousands of jets. These jets impinge at high velocity of the wetted baffles located above each perforation. Suspended matter carried in the jets is trapped by impact with the baffle and is washed away by the scrubbing water flowing across the plate stage. The gas jets, further broken down by impact with the baffle, rise through the layer of water on the plate as minute bubbles, producing intimate contact and a high rate of heat transfer.

The gas then leaves the plate thoroughly cleaned, passes through an entrainment separator made up of

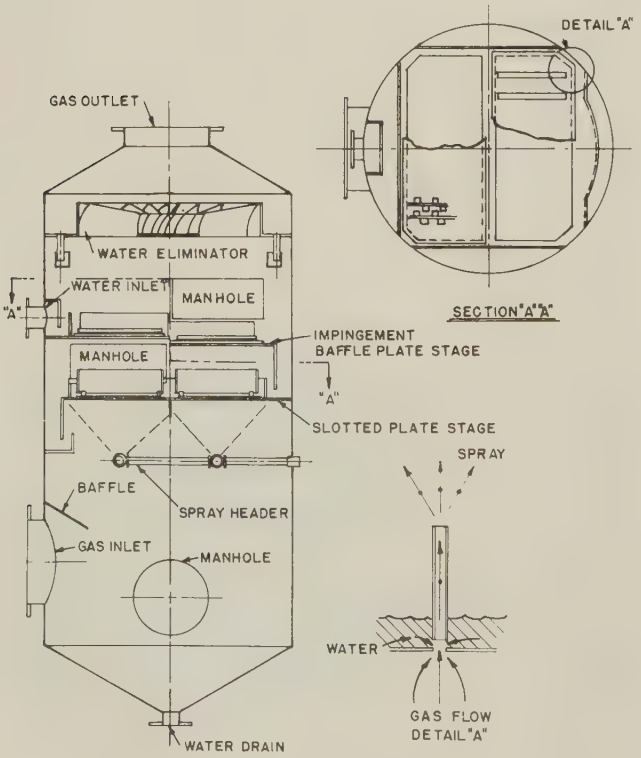


Fig. 2. Line drawing of lime kiln scrubber

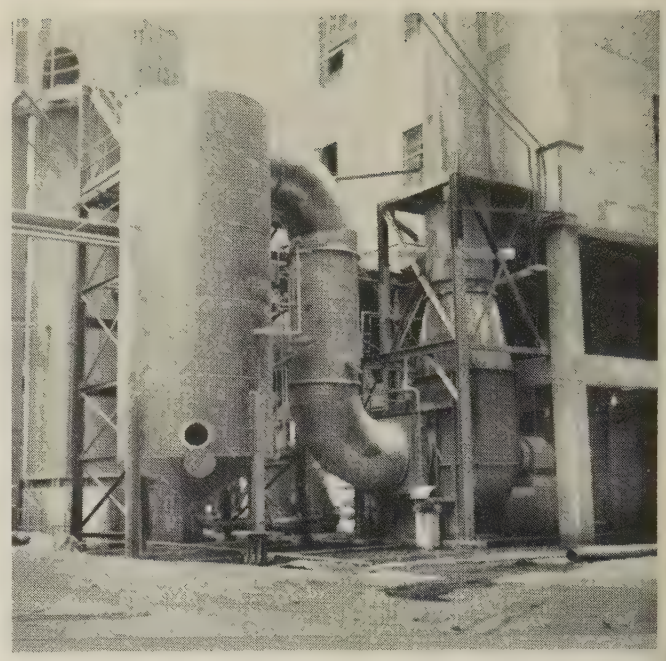


Fig. 3. Scrubber installation

a series of overlapping curved vanes, and discharges into an induced draft fan and thus to atmosphere.

Scrubbing water at 2 or 3 lb. gage pressure enters the unit at one side of the top plate, flows across the plate to a drain and down to the slot stage, across that stage and down to the base of the unit. Spray water at 15 p.s.i.g. enters the spray headers and falls to the base when it joins the scrubbing water coming from the plates. The recovered dust contained in this water may be taken as a dilute slurry as wash to the mud filters and thickeners with 100% fresh water as makeup to the scrubber, or the scrubber discharge may be partially clarified and recirculated with about 20% fresh water makeup.

The gas volume produced by a kiln of given capacity will vary considerably with operating conditions and likewise so will the gas temperature and water vapor content, so that the final design of a scrubber must be checked against the proposed operating conditions.

One of the larger installations is on a kiln 11 ft. in diameter with a rating of approximately 250 tons per day calcine. The gases leave the scrubber at approximately 150°F. and the pressure drop across the scrubber is $4^1/_2$ to $5^1/_2$ in. (water column) at a gas flow of approximately 26,000 std. 60°F. cu. ft. The dust load from the kiln approximates 16 grains per std. cu. ft. while the scrubber discharge averages 0.3 to 0.4 grain showing 97% over-all dust collecting efficiency.

The Chesapeake mill uses a drying system to predry the lime kiln feed and although the gas temperature and volume conditions differ considerably from the standard kiln setup, with the scrubber following a cyclone, the results obtained with the scrubber are similar with 97% plus efficiency being obtained and no maintenance required in a year of continuous operation.

In summary, Peabody scrubbers are proving a very satisfactory solution to the lime kiln dust collection problem and are installed in many modern mills.

Received Dec. 9, 1953. Presented at the 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 15–18, 1954.

ASSOCIATION NEWS AND EVENTS

Local Section Meetings

Pacific: May 18–21, 1955, Empress Hotel, Victoria, B. C. Joint Meeting with Pacific Div., APPMSA and Pacific Branch, CPPA Technical Section.

Kalamazoo Valley: Hotel Harris, Kalamazoo, Mich., May 5, 1955, Western Michigan College thesis presentations, "What Lies Ahead," by Elmer K. Stilbert, Jr., Dow Chemical Co., Midland, Mich.; June, 1955, Gull Lake Country Club, annual meeting.

Chicago: Chicago Bar Association, Chicago, Ill., April 18, 1955, May 16, 1955.

Lake States: Appleton, Wis., May 10, 1955, annual meeting.

New England: June 3–4, 1955, Oceanside House, Magnolia, Mass., annual meeting.

Ohio: May 12, 1955, C. G. & G. Co. Clubhouse, Cincinnati, Ohio, annual meeting.

Lake Erie: May 13, 1955, Carter Hotel, Cleveland, Ohio, annual meeting.

Delaware Valley: May 26, 1955, Engineers Club, Philadelphia, Pa., Edward J. Albert Award Competition.

Empire State: June 9–11, 1955, Whiteface Inn, Lake Placid, N. Y., annual meeting.

Empire State (Northern District): May 11, 1955, Woodruff Hotel, Watertown, N. Y., annual meeting.

Empire State (Metropolitan District): May 10, 1955, Fraunces Tavern, New York, N. Y., annual meeting.

Empire State (Western District): May 4, 1955, Lockport, N. Y., annual meeting.

Empire State (Central District): May 6, 1955, University Club, Syracuse, N. Y., annual meeting.

Empire State (Eastern District): April 21, 1955, Glens Falls Country Club, Glens Falls, N. Y.; May 21, 1955, annual meeting.

Maine-New Hampshire: June 24–25, 1955, Eastern Slope Inn, North Conway, N. H., annual meeting "Paper Machine Operating Problems."

Southeastern: May 13–14, 1955, De Soto Hotel, Savannah, Ga., annual meeting.

Wet Strength and Interfiber Bonding Committee

The new name of the Wet Strength Committee is Wet Strength and Interfiber Bonding Committee. Essentially wet strength is a special type of interfiber bonding. It was felt by the committee that the general field of interfiber bonding in paper is one of fast-growing importance. Such new fields of activity as the air-felting of fibers and the use of artificial fibers place an emphasis on interfiber bonding not previously present.

It is the opinion of the committee that the proposed change in scope will not bring about interference with the activities of other committees. The nearest field of conflict is with the Plastics Committee since artificial bonding agents are often plastics. The new committee will limit its scope to products that are recognizable as paper with the additive present in a relatively minor amount. In contrast the committee considers the plastics field to embody those products in which paper is used as a base material but in which the final products are not generally recognized as being paper.

K. W. Britt of the Scott Paper Co., Chester, Pa., will continue as chairman of the new committee.

Fourth Statistics Conference

The TAPPI Conference on Statistics in the Paper Industry will be held July 10 to July 23, 1955, at the Forest Products Laboratory, Madison, Wis. This is the fourth annual conference and is sponsored by the TAPPI Statistics Committee.

The conference is designed to meet the need for training in both elementary and advanced applications of statistical methods in the paper industry. These methods, used successfully by leaders in all lines of manufacturing, by small companies as well as large, are proving most profitable in the paper industry, also, particularly in the fields of research, production, quality control, and cost reduction.

The conference will consist of two separate concurrent courses, elementary and advanced. The elementary course will give training in understanding and using some of the exceedingly valuable but simpler statistical techniques. This training should prove profitable to organizations now making little or no use of statistical methods but wishing to know more about how they work and how to use them, as well as to those organizations with statistical programs already operating who wish to strengthen their position by having more men with statistical training in their organization.

The advanced seminar course will be for those people who already have some facility and experience in the use of statistical methods. Those enrolling are encouraged to bring their specific problems to the course for individual help and counsel.

A secondary purpose of this conference is to obtain a cross-fertilization of ideas among those people in the paper industry who are working with statistics or who have problems which are statistical in nature. To this end, also, there will be a number of evening speakers chosen from companies in the paper or related industries who are already making successful use of statistical methods.

Enrollment will be limited to 40 in the elementary course and to ten in the advanced seminar, where more highly personalized instruction is provided. A ready facility with mathematics, with a college degree is needed for the elementary course. For the advanced seminar, understanding of the more elementary statistical concepts combined with practical experience in the use of the techniques is essential. (Previous enrollment in the elementary course plus intervening practice in using statistical methods will provide an ideal background.)

The course will be given in the Forest Products Laboratory. Residence will be in Kronshage Hall on the shores of Lake Mendota on the campus of the University of Wisconsin. Fee, including cost of instruction, textbooks, course material, board and lodging will be $200 for the elementary course, $260 for the advanced seminar. Special arrangements may be made for men who wish to bring their wives.

Applications for enrollment should be sent before May 15, 1955, to Fred R. Sheldon, Becco Chemical Division, Food Machinery Corp., Station B, Buffalo 7, N. Y. They will be accepted in the order in which they are received. In order to allow for a wider representation, the committee reserves the right to limit enrollment to four people from any one company or organization.

TAPPI Standards Letter Ballot

In December ballots on two TAPPI Standards were mailed to the membership. Of the 242 ballots returned, the results were as follows: Revision of T 621-42, Analysis of Rosin, as published in *Tappi* 37, No. 5: 148A (May, 1954)—Yes, 224; No, 3; not voting, 15. The revision is accepted, but will be further studied in view of comments received.

Advancement of T 632 m-46, Analysis of Sodium Silicate, to Official Standard—Yes, 223; No, 2; not voting, 15. In view of comments received from the Philadelphia Quartz Co., large manufacturers of sodium silicate, this will be continued as a Tentative Standard for the present.

Division Chairmen

The following division general chairmen were appointed by Karl O. Elderkin at the annual meeting of the Technical Association:

Engineering: John D. Lyall, Armstrong Cork Co., Lancaster, Pa.
Industrial: Roy L. Davis, Scott Paper Co., Detroit, Mich.
Research Development: Joseph J. Thomas, S. D. Warren Co., Cumberland Mills, Me.
Testing: James P. Casey, A. E. Staley Mfg. Co., Decatur, Ill.
Pulp Manufacture: E. O. Ericsson, Puget Sound Pulp & Timber Co., Bellingham, Wash.
Paper Manufacture: Harry C. Moore, Beloit Iron Works, Beloit, Wis.
Converter and Consuming: F. D. Long, Container Corp. of America, Chicago, Ill.

Local Section Representatives

President Elderkin has appointed the following members of the TAPPI Executive Committee as official representatives designated to local sections:

Pacific: E. O. Ericsson, Puget Sound Pulp & Timber Co., Bellingham, Wash.
Lake States: John C. Wollwage, Kimberly-Clark Corp., Neenah, Wis.
Delaware Valley: John D. Lyall, Armstrong Cork Co., Lancaster, Pa.
Kalamazoo Valley: Roy L. Davis, Scott Paper Co., Detroit, Mich.
New England: Norman I. Bearse, Champion-International Co., Lawrence, Mass.
Maine-New Hampshire: Joseph J. Thomas, S. D. Warren Co., Cumberland Mills, Me.
Empire State: Charles J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.
Ohio: Donald J. Goodman, Sorg Paper Co., Middletown, Ohio
Lake Erie: Donald J. Goodman
Chicago: F. D. Long, Container Corp. of America, Chicago, Ill.
Southeastern: James R. Lientz, Union Bag & Paper Corp., Savannah, Ga.

Local Sections Committee

President Elderkin has appointed the following Executive Committeemen as members of the Local Sections Committee:

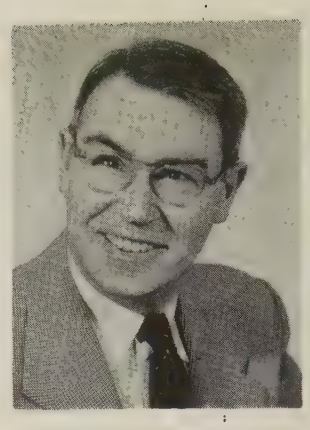
J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.
E. O. Ericsson, Puget Sound Pulp & Timber Co., Bellingham, Wash.
D. J. Goodman, Sorg Paper Co., Middletown, Ohio
N. I. Bearse, Champion-International Co., Lawrence, Mass.
R. L. Davis, Scott Paper Co., Detroit, Mich.
F. D. Long, Container Corp. of America, Chicago, Ill.

New Committee Chairman

Irving H. Isenberg, Institute of Paper Chemistry, Appleton, Wis., has been appointed chairman of the Microscopy Committee succeeding C. E. Brandon, of the Howard Paper Mills, Dayton, Ohio.

Arthur Thurn, Champion Paper & Fibre Co., Hamilton, Ohio, has been appointed chairman of the Water Committee succeeding A. S. Erspamer of the Hollingsworth & Whitney Co., Div. of the Scott Paper Co., Waterville, Me.

L. Price of the Government Printing Office, Washington, D. C., has been appointed chairman of the Paper Testing Committee succeeding Donald H. Newcomb, Riegel Paper Corp., Warren Glen, N. J.



I. H. Isenberg, The Institute of Paper Chemistry, Chairman, Microscopy Committee

Arthur Thurn, Champion Paper & Fibre Co.; Chairman, Water Committee

College Alumni Chairmen

At the TAPPI Annual Meeting the following college alumni group chairmen were elected:

Massachusetts Institute of Technology: Ralph W. Peters, Eastman Kodak Co., Rochester, N. Y.

University of Maine: Donald W. Libby, Robert Gair Co., Uncasville, Conn.

College of Forestry, State University of New York: L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio.

Fundamental Research Conference

The Fundamental Research Committee will sponsor a 3-day conference on "The Theories of Bleaching" at The Institute of Paper Chemistry, Appleton, Wis., on Sept. 15–17, 1955.

Fifth Testing Conference

The Fifth Testing Conference of the Technical Association of the Pulp and Paper Industry will be held at the Sheraton Kimball Hotel, Springfield, Mass., Sept. 28–30, 1955.

Ninth Alkaline Pulping Conference

The Ninth TAPPI Alkaline Pulping Conference will be held at the Hotel Patten, Chattanooga, Tenn., on Oct. 19–21, 1955.

Sixth Coating and Graphic Arts Conference

The Sixth TAPPI Coating and Graphic Arts Conference will be held at the Statler Hotel, Cleveland, Ohio, on May 23–25, 1955. Registration will begin on Sunday afternoon, May 22 at 6 p.m.

Richard T. Trelfa is chairman of the Coating Committee which is sponsoring the conference. J. D. Davis, Mead Corp., Chillicothe, Ohio, is general conference chairman and Jack Wilber, of the St. Regis Paper Co., Deferiet, N. Y., is technical program chairman.

The feature luncheon speaker will be George K. Ferguson, president of the Watervliet Paper Co., Watervliet, Mich., whose subject will be "Coating Frontiers."

There will be an exhibit dealing with coating pigments and pigment processing equipment.

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. . . in bleaching sulfate pulp

Peroxide bleaching with the Du Pont process can give you a better-selling combination of brightness and strength for kraft. You can bleach sulfate pulps to high brightness with good strength characteristics . . . or normal brightness with premium strength.

Your yield stays high, since there is little or no loss due to bleaching. And the bleached pulp is highly uniform . . . variations that occur in multi-stage bleaching are smoothed out by the process.

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You'll save with exceptionally high fiber yields . . . low waste disposal . . . improved opacity in same weight sheet . . . more rapid drainage during paper manufacture.

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. . . in waste paper recovery

You can produce high-grade pulp from low-grade waste paper with the Du Pont Peroxide Process. Your pulping time is cut . . . your yields improved. Recovered pulp is bright, strong, stable, and highly uniform—regardless of groundwood content.

Lower pulping temperature means reduced steam costs . . . consumption of hypochlorite can be cut as much as 25%. And the stock you produce has better color stability.

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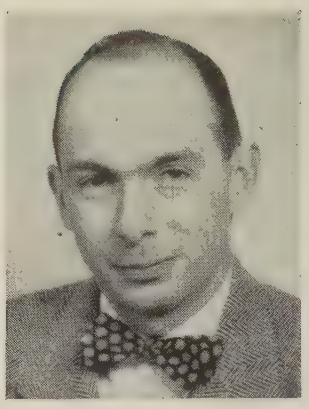

R. T. Trelfa, Watervliet Paper Co.

Local arrangements are being handled by the Lake Erie Section of TAPPI.

An innovation of the conference will be a session sponsored by the TAPPI Graphic Arts Committee, its first appearance at an Association regional conference.

The principal plant visit will be made to the plant of the Ohio Boxboard Co. at Rittman, Ohio. Alternate visits have been arranged to the plants of the Glidden Co. and Sherwin-Williams printing plants in Cleveland.

Room reservations should be made direct with the Statler Hotel, Cleveland, Ohio.

The program follows:

Monday, May 23, 1955

8:00 a.m. REGISTRATION

10:30 a.m. GENERAL SESSION

J. E. WILBER, St. Regis Paper Co., Deferiet, N. Y., *Chairman*

OPENING REMARKS by J. D. Davis, Mead Corp., Chillicothe, Ohio, and R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich.

1. "Trends in the Manufacture and Use of Coated Paper" (Tentative).
2. "A Method for Deaerating Coating Color," by John Gunning of Provincial Paper Co., Ltd., Georgetown, Ont.
3. "An Electrostatic Process for Applying Dry Coatings on Paper," by Robert Reif, Battelle Memorial Institute, Columbus, Ohio.

2:00 p.m. GENERAL SESSION

C. G. ALBERT, Minerals & Chemical Corp. of America, Edgar Division, McIntyre, Ga., *Chairman*

4. Keynote Speaker on Pigments, Gerald Haywood, West Virginia Pulp & Paper Co., Luke, Md.
5. "Mineral Species in Coating Clays and Their Relationships to Flow Properties at High Solids Content," by John Swanson and Glen Hemstock, The Institute of Paper Chemistry, Appleton, Wis.
6. "Clay Deflocculation and Its Effect on the Flow Properties of Clay Slips," by J. W. Swanson and G. Hemstock, The Institute of Paper Chemistry, Appleton, Wis.
7. "Some Aspects of Dispersion," by W. R. Willets and L. E. Georgevits of Technical Service Laboratories, Titanium Pigment Corp., New York, N. Y., present address: The Borden Co., Bainbridge, N. J.

Tuesday, May 24, 1955

9:00 a.m. GENERAL SESSION

W. R. WILLETS, Titanium Pigment Corp., New York, N. Y., *Chairman*

1. "Calcium Carbonate Pigments," by R. W. Hagemeyer, Wyandotte Chemical Corp., Wyandotte, Mich.
2. "Progress Notes on Machine Coating," by B. W. Rowland, Georgia Kaolin Co., Elizabeth, N. J.
3. "Varnish Resistance of Various Clays and Pigments," by John C. Rice of Lowe Paper Co., Ridgefield, N. J.
4. "Some Fundamental Properties of Commercial Talcs and Their Application to Papermaking," by R. S. Lamar and M. F. Warner of Sierra Talc & Clay Co., South Pasadena, Calif.
5. "Tinting and Coloring of Water Vehicle Coatings," by M. J. Landberge of General Dyestuff Co., Div. of General Aniline & Film Corp., Rensselaer, N. Y.
6. "A New Replica Technique for Making Electron Micrographs of Coated Paper Surfaces," by J. J. Comer and H. W. Stetson, Pennsylvania State University, State College, Pa., and S. C. Lyons, Georgia Kaolin Co., Dry Branch, Ga.

12:30 p.m. LUNCHEON—Address by George K. Ferguson, President, Watervliet Paper Co., Watervliet, Mich.—"Coating Frontiers."

2:30 p.m. PANEL DISCUSSION ON PIGMENTS

J. W. SWANSON, Institute of Paper Chemistry, Appleton, Wis., *Moderator*

6:30 p.m. Lake Erie Section Dinner Meeting (Hotel Carter)

PANEL DISCUSSION ON COATED PAPERBOARD

Melvin Johnson, Container Corp. of America, Wabash, Ind.

H. C. Fisher, Gardner Board & Carton Co., Cincinnati, Ohio

Wednesday, May 25, 1955

9:00 a.m. GRAPHIC ARTS SESSION

C. A. MORTON, West Virginia Pulp & Paper Co., Chicago, Ill., *Chairman*

1. "Coated Paper Requirements for High-Speed Letterpress Printing," by A. Glassman, R. R. Donnelly & Sons Co., Chicago, Ill.
2. "Coated Paper Properties and Their Relation to Printability and Print Quality in Lithography," by R. F Reed of Lithographic Technical Foundation, Chicago, Ill.
3. "An Approach to the Printability Evaluation, Problem," by J. Homer Winkler, Battelle Memorial Institute, Columbus, Ohio.
4. "Coated Paper Requirements for High-Speed Letterpress Printing," by Alex Glassman, R. R. Donnelly & Co., Chicago, Ill.
5. "Ink Film Splitting," (film), I. P. I. Div., Interchemical Corp., New York, N. Y.

2:00 p.m. PLANT VISITS

Ohio Boxboard Co., Rittman, Ohio, The Glidden Co., Cleveland, Ohio, Sherwin-Williams Co. printing plant.

Thursday, May 26, 1955

Enroute home from the meeting members are invited to visit the mills of the Hammermill Paper Co., Erie, Pa., Bettner-Shellmar Div., Continental Can Co., Mt. Vernon, Ohio, and the Consolidated Paper Co., Monroe, Mich.

TAPPI Engineering Division

The present chairmen and secretaries of the TAPPI Engineering Division are as follows:

General Chairman—John D. Lyall, Armstrong Cork Co., Lancaster, Pa.

General Secretary—W. C. Bloomquist, General Electric Co., Room 510, Bldg. 2, Schenectady, N. Y.

Chemical Engineering Committee:

Chairman—Lyle C. Jenness, Department of Chemical Engineering, University of Maine, Orono, Me.

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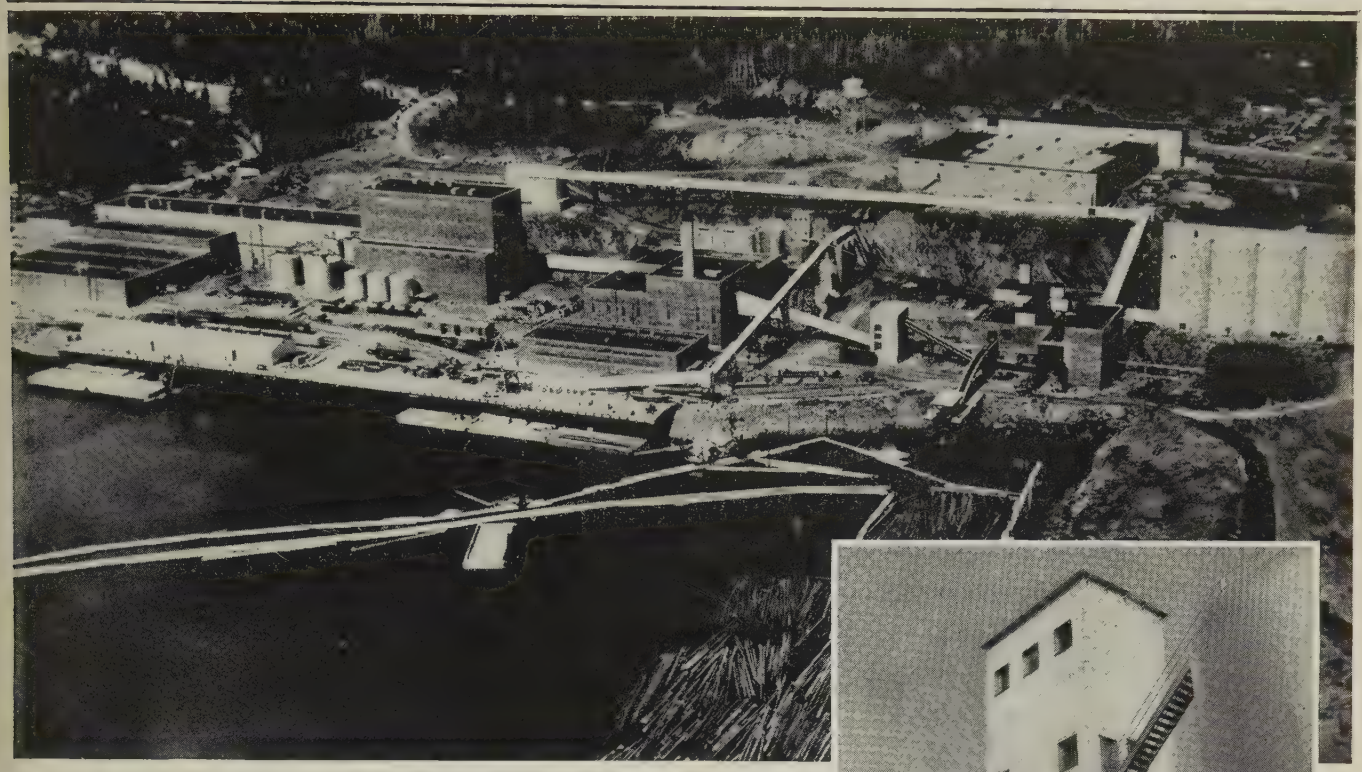

Conveying duct from car to Airveyor filter in penthouse; delivers to and reclaims from storage bins.

Ketchikan Pulp Company joins a long list of users

International Paper	Crown-Zellerbach
Fibreboard Products	St. Helens Pulp & Paper
St. Regis Paper	Scott Paper
Buckeye Cellulose	New York & Pennsylvania
Hudson Pulp & Paper	Bare Paper
Rayonier, Inc.	Glatfelter Co.
Macon Kraft	Bowaters-Southern
Gaylord Container	East Texas Pulp & Paper
Brown Paper Mill	Champion Paper & Fibre
Eastern Corp.	Camp Mfg. Co.
Fraser Paper	Chesapeake Corp. of Va.
Oxford Paper	Puget Sound Pulp & Timber
W. Virginia Pulp & Paper	Weyerhaeuser Timber
Tileston & Hollingsworth	Consolidated W. P. & Paper
Fitchburg Paper	Kimberly-Clark
Escanaba Paper	MacMillan & Bloedell
Blandin Paper	Smith Paper Mills
Minnesota & Ontario Paper	Dryden Paper
Brown Co.	KVP Company
Finch-Pruyn	Marathon Paper
Newton Falls Paper	Ontario Paper
Riegel-Carolina	Brown Corp.
Chillicothe Paper	Canada Paper
Mead Corporation	Ketchikan Pulp
Oxford-Miami	

Again, another Airveyor system has been put into operation, this time in the first major industrial plant in Alaska—the Ketchikan Pulp Company's 50 million dollar plant at Ward Cove, producing 300 tons daily of the highest qualities of chemical cellulose for U. S. and world-wide markets.

The Airveyor system handles bulk magnesium oxide, conveying from cars to two storage bins; reclaims from either of these storage bins for transfer to a day bin. The system is so arranged that materials can be recirculated from one storage bin to another if desired. Conveying rate for any of the above operations, 10 tons an hour . . . rapid, clean, efficient conveying all the way—from cars to process.

The pulp and paper industry has learned by experience that the Airveyor is engineered and built for superior performance for its particular use. Why not have a Fuller engineer make a study of your conveying problems . . . such a study costs you nothing, obligates you in no way.

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Corrosion Committee:
Chairman—Stephen J. Baisch, Thilmany Pulp & Paper Co., Kaukauna, Wis.

Data Sheet Committee:
Chairman—J. W. Hemphill, Johns-Manville Sales Corp., 22 E. 40th St., New York 16, N. Y.
Secretary, A. J. Winchester, TAPPI, New York, N. Y.

Drying and Ventilating Committee:
Chairman—Curt A. Young, Riegel Paper Corp., Milford, N. J.
Secretary—R. M. Cook, Ross Midwest-Fulton Corp., Dayton, Ohio.

Electrical Engineering Committee:
Chairman—M. J. Osborne, Bowaters Southern Paper Corp., Calhoun, Tenn.
Vice-Chairman—R. E. Crossley, Great Northern Paper Co., Millinocket, Me.
Secretary—R. R. Baker, Westinghouse Electric Corp., E. Pittsburgh, Pa.

Engineering Research and Machine Design Committee:
Chairman—R. G. Quinn, Johns-Manville Research Corp., Manville, N. J.
Secretary—R. D. Irwin, Minneapolis-Honeywell Regulator Co., Brown Instrument Division, Philadelphia, Pa.

Hydraulics Committee:
Chairman—K. J. Mackenzie, Eastman Kodak Co., Rochester, N. Y.

Industrial Engineering and Materials Handling Committee:
Chairman—J. M. MacBrayne, Union Bag & Paper Corp., Savannah, Ga.
Vice-Chairman—Fred D. Helverson, Crown Zellerbach Corp., San Francisco, Calif.
Secretary—H. A. Stoess, Jr., Fuller Co., Catasauqua, Pa.

Mill Maintenance and Materials Committee:
Chairman—L. L. Mrachek, The Mead Corp., Kingsport, Tenn.
Secretary—H. K. Ferguson, Allis-Chalmers Mfg. Co., 4620 Forest Ave., Norwood 12, Ohio.

Mill Planning and Economics Committee:
Chairman—R. A. Packard, 85 Grove St., Hopkinton, Mass.
Secretary—P. A. Forni, Mohawk Paper Mills, Cohoes, N. Y.

Sanitary Engineering Committee:
Chairman—G. M. Griffith, West Virginia Pulp & Paper Co., Luke, Md.
Secretary—Edwin M. Kass, Gibbs & Hill, New York, N. Y.

Steam and Power Committee:
Chairman—W. Wyburn, Federal Paper Board Co., Bogota, N. J.
Vice-Chairman—J. Mailhos, National Container Corp., Valdosta, Ga.
Secretary—V. P. Owens, Combustion Engineering, Inc., 200 Madison Ave., New York 16, N. Y.

French ATIP

The Association Technique de l'Industrie Papetiere will hold its Eighth Annual Meeting at Grenoble, France, on May 16–18, 1955. Following is the program:

1. "Hemicelluloses and Their Properties," by M. Chene, Paper School, Grenoble, France.
2. "The Walls of Tracheids," by D. Bucher, Attisholz A/G, Attisholz, Switzerland.
3. "Kraft Pulp Beating," by D. Colombo, Vita Mayer Co., Milan, Italy.
4. "Straw Cooking," by G. Vamos, Pulp & Paper Research Inst., Budapest, Hungary.
5. "Durability of Paper," by D. van Royan, Vezel-institut, Delft, Holland.
6. "Acidity of Paper," by R. Seve, Kodak Research Laboratory, Paris, France.
7. "Quality Control," by J. Laroche, Papeteries de Nauterre, France.
8. "Control of Papermaking Variables," by M. Pfulg, Geneva, Switzerland.

Visits to Papeteries de Renage and Cartonneries de la Rochette, French Paper School and Neyret Beylier, machine builder.

LETTERS TO THE EDITOR

Latices of Cellulose Derivatives

To the Editor, *Tappi:*

May I once more apply to your kind assistance asking you for information on the following data which I require for our studies in cellulose problems:

Can you tell us if and where data are available on lattice dimensions of:

1. Ammonia cellulose.
2. Cellulose triacetate.
   (a) Prepared in heterogeneous system (maintaining the fibrous state during reaction).
   (b) Prepared by dissolving the fiber and
   (alpha) crystallizing from solution.
   (beta) precipitating.
3. Secondary cellulose acetates (acetone soluble if sufficiently defined products have already been measured.
4. Nitrocellulose.

HEINZ TEMMING
Peter Temming A/G
Gluckstadt, Germany

To the Editor, *Tappi:*

Data on the lattice dimensions of cellulose derivatives are available in various places. I have listed only a few readily available references below.

1. Ammonia cellulose—Hess and Gundermann, *Ber.* 70B: 1788 (1937).

2. Cellulose triacetate—All the modifications you list are discussed by Hess and co-workers in *Z. phys. Chem.* B5: 161 (1929): B7: 1 (1930): B15: 157 (1932), although it is likely that some of Hess's acetates were highly degraded. Herzog (*Helv.* 9: 631 [1926]) has measured the fibrous modification and Spence (*J. Phys. Chem.* 45: 401 [1941]) has measured sheets.

3. Secondary acetate—Happey, *J. Text. Inst.* 41 T 381 (1950).

4. Nitrocellulose—The previous reference covers nitrocellulose and cellulose triacetate as well as the secondary acetate.

KYLE WARD, JR.,
Research Associate
Institute of Paper Chemistry
Appleton, Wis.

Chipper Quality Control

To the Editor, *Tappi:*

In *Tappi*, July, 1954, Volume 37, Number 7, Page 300, we have read with great interest the article by Vance P. Edwardes on chipper operation.

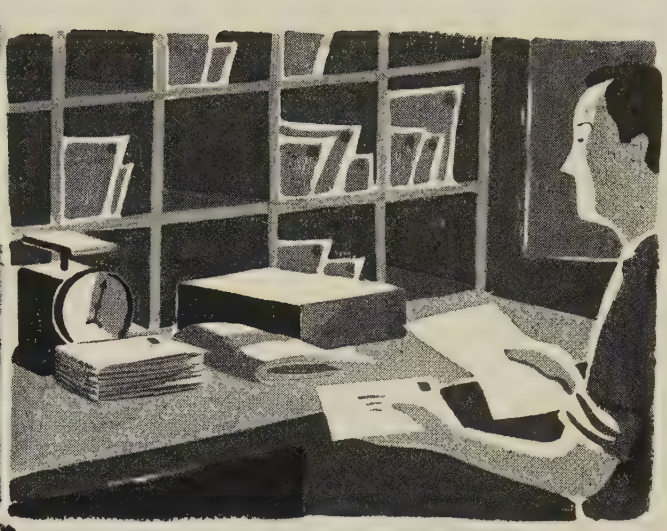
As we intend to make similar studies in our mill, we would ask you to kindly notify us the producer of the small motor-driven nest of screens mentioned on page 302 or perhaps provide us the designs of this device in order to enable us to build it in our mill.

Furthermore we would ask you to kindly advise us the method of investigation applied according to the above article.

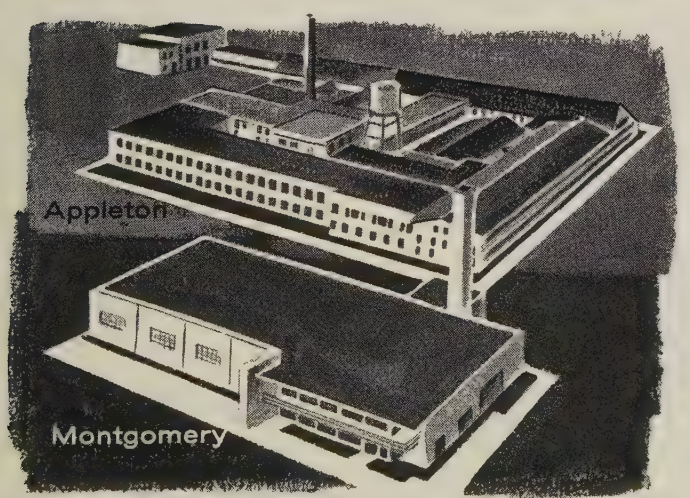
LENZINGER ZELLULOSE- UND PAPIERFABRIK A/G
Lenzing, Austria

To the Editor, *Tappi:*

Enclosed is an advertisement of the Williams Apparatus Co. which manufactures the chip screen to which I referred in my article. The W. S. Tyler Co. of Cleveland 14, Ohio, also



Paper enlightens--informs--entertains



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make a laboratory chip screen which would be suitable. Both of these firms may have European representatives but inquiry should be made to them direct.

The usual practice followed is for the wood room foreman to test chip quality at intervals during the day to determine the need for knife change and to detect any unusual condition causing poor chips, such as incorrect knife or bed plate setting. By having a simple testing unit in the wood room the production of a large quanity of poor chips can be prevented.

VANCE P. EDWARDES
Corinth, N. Y.

Paper Shrinkage

To the Editor, *Tappi:*

I wish to take this opportunity to ask you about a problem raised by a customer of ours, regarding shrinking of napkin paper and shrinking of damask paper made with bleached sulphite pulp suitable for tissue papers.

When the damask paper comes out of the machine, it is quite all right, without any fold. However, after having kept the paper in stock during a few days only, the paper curls and the surface of the paper does not stay level. It is apparent that there are some tensile actions in the paper, but unfortunately some are out of control.

Please also take into account the fact that the air is much damper here than in the most parts of North America, except perhaps in New York.

J. TASIAUX, *Managing Director*
Continental Cellulose S/A Brussels, Belgium

To the Editor, *Tappi:*

I'm afraid there is not too much that I can contribute in the way of a practical papermaking explanation as to the cause of curl in a sheet of paper after it has left the paper machine. The lack of operational details, too, makes it difficult to discuss the problem specifically.

The operating variables that might cause curling are: (a) wetness of the sheet as it hits the driers; (b) formation: and (c) the draw, especially when creping is practiced (as it usually is in light weight papers such as facial, towelling, etc.). I would expect the first to be the critical one in the case of which Mr. Tasiaux speaks; it would appear that when the paper was made it was too wet when it met the hot driers and probably left the drier section at a somewhat relatively higher moisture content.

Such nonuniform drying results in a two-sided sheet in terms of fiber set or stress-strain relationship; under certain conditions the fibers on one side of the sheet would exert tension forces greater than those on the other and the sheet would naturally curl in an attempt to relieve the stress. Proper or adequate drying would set or condition the fibers on both sides so that the tension forces would be in equilibrium under most conditions, especially those of humidity where the explanation would be based on the expansion or contraction of fiber through the absorption or release of moisture. In practice, each sheet of paper has a fiber-conditioning history which sets the humidity limits (or equilibrium moisture content) in which it will not show any signs of curl, that is to say, each sheet will have its own tolerance for curl. Apparently, the sheet in question wasn't up to the "humid" conditions that seem to exist in Belgium. Possibly rewetting and drying the paper would relax the tensions.

This explanation is probably too long-winded; if you should get a more accurate explanation (and you probably will), I'd be very interested in hearing of it.

DONALD E. HELLEUR, *Technical Director*
Groveton Papers Company
Groveton, N. H.

To the Editor, *Tappi:*

I do not know exactly what the trouble is, but from a definition of "damask paper" it is a writing paper that has been embossed. I am surprised that such a sheet will curl, but the problem can be twofold—he may be having expansion trouble due to a moisture pickup which will cause severe waviness, or a drying out which would give "puffiness" and curl. The latter I doubt in view of the remarks on humidity although if used in a heated room he may be encountering curl.

I presume houses and plants are heated during the winter season which would lower the outside humidity considerably, as it does in our climate, and would warrant air conditioning.

J. H. COWAN, *Manager Quality Control*
The E. B. Eddy Co.
Hull, P. Q.

Water Resistance of Paper and Paperboard

To the Editor, *Tappi:*

We are having difficulty obtaining the indicator powder for testing purposes under Par. F5a, 2aL of JAN-P—117, Federal Specification.

As this is a TAPPI test, we are wondering if you could furnish us with a source for this material.

G. E. MEYER
Vanant Products, Inc.
Tomah, Wis.

To the Editor, *Tappi:*

The indicator powder for use in TAPPI Standard T 433 m, "Water Resistance of Paper and Paperboard," is specified as follows:

"The water-transudation indicator is composed of pure, powdered cane sugar, pure soluble starch, and methyl violet dye (du Pont N. E. methyl violet, National Aniline and Chemical Co. 2 B.P. methyl violet, or equivalent). Pass each ingredient separately through a No. 100 screen, and completely dry it in a desiccator over anhydrous $CaCl_2$ before making the mixture. When dry, weigh and mix the following proportions by weight:

Sugar	45
Soluble starch	5
Dye	1

Mixing the ingredients by screening repeatedly through a No. 60 screen until the mixture is uniform. Keep the indicator in a desiccator when it is not being used. (The prepared indicator may be obtained from the M. Ames Chemical Works, Inc., 21 Rogers St., Glens Falls, N. Y.)

Note: The powdered sugar may be prepared by grinding granulated or "domino" sugar. Confectioners' sugar must not be used, as it contains starch."

A. J. WINCHESTER
TAPPI, New York, N. Y.

Turpentine Test for Grease Resistance

To the Editor, *Tappi:*

This is in regard to the variance of reports on the greaseproof tests from different laboratories. The basic problem, as stated, seems to be one of interpretation.

The laboratory here in Boston uses the standard TAPPI greaseproof test and considers a greaseproof failure as soon as there is any sign whatosoever of red dye showing on the book paper. The other laboratory, however, does not consider a failure to be such until the stain can be proven not to be a pinhole penetration but an actual breakdown of the greaseproof paper itself.

We would greatly appreciate if the Paper Testing Committee could take this problem in hand so that something more definite can be reached by the testing laboratories. Both the

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MEKON* Y-20	190-195	3-5	YELLOW—3-3½	0.0	0.0	MICRO-CRYSTALLINE HARD & BRITTLE
FORTEX*	190-200	3-5	2½-3½	0.0	0.0	MICRO-CRYSTALLINE HARD & PLASTIC
WARCO* WAX 180	180-185	4-7	WHITE	0.0	0.0	MICRO-CRYSTALLINE HARD & BRITTLE
WARCO* WAX 170-A	170-175	10-15	YELLOW 1-2	0.0	0.0	MICRO-CRYSTALLINE PLASTIC
WARCO* WAX 150-A	145-155	15-20	YELLOW 1-2	0.0	0.0	MICRO-CRYSTALLINE PLASTIC
WARCOSINE*	150-155	15-20	WHITE	0.0	0.0	MICRO-CRYSTALLINE PLASTIC
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laboratories mentioned here are of high repute and insist they are following the test as set up by TAPPI.

Primarily, it is the following sentence which I believe should be studied so that the various laboratories can agree on the end result.

"The time elapsed, in seconds, between the application of the turpentine and the appearance of the first definitely red stain shall be recorded as the transudation time."

KERMIT GREENE, *Technical Director*
Sherman Paper Products Corp.
Newton Upper Falls, Mass.

To the Editor, *Tappi:*

I have your letter regarding T 454 m-44, "Turpentine Test for Grease Resistance." I think that tests in which the penetration is obviously due to a pinhole should be rejected, and the method should so state. As the method was partly based on a study conducted by the Glassine and Greaseproof Manufacturers Assoc., it might be well to check their opinion on this point.

I have a note on my master copy of the method that it was under study for revision by the Paper Testing Committee in May, 1953, but have heard nothing further. The method has been turned down at least once as not suitable for advancement to an official standard.

We have a method for Pinholes in Glassine and Greaseproof Papers, T 485 m-53. It seems to me that an excessive amount of pinholes would have an adverse effect in rating greaseproofness and that there might be a tie-in between the two methods. At any rate the Paper Testing Committee should promptly tackle this question of greaseproof tests and their interpretation.

ROGER C. GRIFFIN, *Chairman*
TAPPI Standards Committee
Needham, Mass.

To the Editor, *Tappi:*

Replying to your letter on TAPPI Standard T 454 m-44 the above subject, we agree with the laboratory in Boston which uses the standard TAPPI greaseproof test and considers a greaseproof failure as soon as there is any sign whatsoever of red dye showing on book paper.

We do not agree with the other laboratory which does not consider failure to be such until the stain can be proven not to be a pinhole penetration. We consider a pinhole penetration to be a failure.

THOMAS J. BURKE, *Secretary-Treasurer*
Glassine & Greaseproof Manufacturers Assoc.
New York, N. Y.

Heating of Steam Boilers with Sulphite Spent Liquor

To the Editor, *Tappi:*

In the November, 1952, issue of *Energie* we read that in U.S.A. 2.8% of all industrial boilers are heated with sulphite spent liquor. Referring to capacity, this would correspond to 4.4% of the total volume of generated steam. It is the average of a total of 17 plants. This information was gathered from the March, 1952, issue of *Power.*

We cannot very well imagine that 2.8% of all industrial boilers in U.S.A. are heated with sulphite spent liquor and are under the impression that some mistake has slipped in and that the correct wording should probably be that in U.S.A. 2.8% of all industrial boilers of the sulphite cellulose industry are heated with sulphite spent liquor.

We should be greatly obliged to you, if you could give us detailed clarification of the above. We are specially interested to know how many sulphite cellulose factories in U.S.A. are actually thickening the whole of their accumulating sulphite spent liquor to heat the steam boilers. Furthermore, we should be grateful to learn if the sulphite spent liquor of the cellulose factories is also used for purposes other than burning and utilizing it for the generation of steam.

Lurgi Gesellschaft für Chemie und Hüttenwesen
Frankfurt am Main, Germany

To the Editor, *Tappi:*

I am enclosing my comments on the letter from Germany concerning the burning of sulphite spent liquor. Information of this type is very meager, but I have received some help from Combustion Engineering, Inc.

The answer to question 1 could be right when you consider that the figure of 2.8% pertains to all industrial boilers in the sulphite cellulose industry rather than just in the United States. It could be true if it means the sulphite cellulose pulping mills and does not include any boilers used for the generation of power and steam for paper machines.

Our country's sulphite cellulose industry is just getting started on sulphite spent liquor burning so that the percentage factor is still very low here. On the other hand, the percentage of sulphite mills burning their spent liquor in the Scandinavian countries is very high because of the necessity resulting from their high steam costs.

The only mills I know of who are evaporating waste liquor for burning in the U.S.A. are: Northern Paper Co. at Green Bay, Wis.; Consolidated Water Power and Paper Co. at Appleton, Wis.; National Container Corp. at Tomahawk, Wis., Rayonier at Shelton, Wash., Crown-Zellerbach at Lebanon, Ore.; Weyerhaeuser at Longview, Wash.; and Ketchikan Pulp Co. at Ketchikan, Alaska. The latter two mills are on magnesium base.

There may be some other mills doing something along this line, but the number will be few and the quantity of liquor treated would be very small.

The consumption of sulphite spent liquor for uses other than burning is very small. The Rhinlander Paper Co. in Wisconsin is running a yeast plant with their sulphite liquor, and it may be that one or two plants in the Midwest are doing the same. Puget Sound Pulp and Timber Co. at Bellingham, Wash., is making alcohol and evaporating some spent liquor to make extender for cements. The Marathon Co. in Wisconsin is manufacturing vanillin from sulphite spent liquor.

N. S. LEA, Chairman
TAPPI Acid Pulping Committee
Everett, Wash.

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James F. Bakken, Technical Associate, The Institute of Paper Chemistry, Appleton, Wis., a 1950 graduate of Iowa State College.

Bernard H. Bamer, Plant Manager, Stone Container Corp., Coshocton, Ohio. Attended Purdue University.

Richard E. Beaton, Paper Chemist, The Goodyear Tire & Rubber Co., Akron, Ohio, a 1950 graduate of the New York State College of Forestry.

Elmer W. Bennett, Jr., Chief Chemist, Gilman Paper Co., Gilman, Vt., a 1943 graduate of Worcester Polytechnic Institute.

Jean Brodschi, Laboratory Chief, Societe Alsacienne d'Aluminum, Haute-Savoie, France, a 1938 graduate of École de Chimie de Bordeaux, with a D.Sc. degree.

John F. Buttimer, Process Engineer, Union Bag & Paper Co., Savannah, Ga., a 1951 graduate of Catholic University of America.

John A. Comly, Plant Superintendent, Connelly Containers, Pencoyd, Pa., a 1938 graduate of the University of Pennsylvania.

James M. Cordrey, Process Supervisor, E. I. du Pont de Nemours & Co., Inc., Penns Grove, N. J., a 1944 graduate of Lehigh University.

William S. Cramp, Resident Manager, St. Lawrence Corp. Ltd., Three Rivers, P. Q., Canada, a 1929 graduate of McGill University.

Wayne T. Crannell, Sales Manager, Patton Mfg. Co., Inc., Springfield, Ohio. Attended Lehigh University.

William H. Cuffey, Jr., Physicist, Kimberly Clark Corp., Kimberly, Wis., a 1948 graduate of the University of Michigan.

Roy P. Daniels, Chief Chemist, Gulf Oil Corp., Port Arthur, Texas, a 1926 graduate of Louisiana State University.

Edward G. DeGalan, Associate Technologist, General Foods Corp., Central Laboratories Div., Hoboken, N. J., a 1952 graduate of Western Michigan College.

Terrence W. Dobson, Chief Chemist, Donnacona Paper Co. Ltd., Donnacona, P. Q., Canada, a 1948 graduate of Queen's University.

Arthur L. Dunnam, Bleach Plant Chemist, Hollingsworth & Whitney Div., Scott Paper Co., Mobile, Ala., a 1953 graduate of the University of Alabama.

Arthur J. Flint, Chemical Engineer, Buckeye Cotton Oil Co., Memphis, Tenn., a 1948 graduate of Louisiana State University.

Wallace J. Follette, Assistant Chief, Paper Products Development Section, Crown Zellerbach Corp., Camas, Wash., a 1948 graduate of Oregon State College.

Robert E. Fones, Jr., Student, Institute of Paper Chemistry, Appleton, Wis., a 1953 graduate of Texas University.

John F. Frisch, Mechanical Engineer, Technical Section, Canadian Pulp & Paper Assn., Montreal, P. Q., Canada, a 1952 graduate of McGill University.

Eugene E. Gale, Technical Service Representative, Polymer Corp. Ltd., Sarnia, Ont., Canada, a 1949 graduate of McMaster University.

Colin S. Gibson, General Manager, Tasmanian Board Mills Ltd., Launceston, Tasmania, a graduate of the University of Tasmania.

Philippe L. Ginsburger, Assistant Technical Manager, Societe CENPA, Paris, France, a 1947 graduate of École Centrale des Arts et Manufacture.

Lee V. Graham, Jr., Assistant Chief of Power, Maintenance and Planning, St. Regis Paper Co., Pensacola, Fla., a 1938 graduate of Clemson College.

C. Gunnar Haeger, President, Inlands A/B and Alstermo Bruks A/B, Lilla Edet, Sweden, a 1916 graduate of the Technical University of Stockholm.

Robert T. Hart, Assistant Director of Research, S. D. Warren Co., Cumberland Mills, Me., a 1938 graduate of the University of New Hampshire with a Ph.D. degree from Ohio State University in 1946.

Gunnar S. Hasselberg, Mill Manager, Skanes Cellulosa A/B, Kristianstad, Sweden, a 1949 graduate of Chalmers Technical University.

George S. Herbert, General Manager, Paper Mill Div., Patton Mfg. Co., Inc., Springfield, Ohio, a 1949 graduate of Denison University.

Delmer D. Hinrichs, Junior Research Chemist, Crown Zellerbach Corp., Camas, Wash., a 1949 graduate of Oregon State College.

Odd Hultgreen, President, Converters Machine Co., Greenwich, Conn., a 1929 graduate of Altenburg College of Engineering.

George R. Hunt, Jr., Research Chemist, Scott Paper Co., Chester, Pa., a 1955 graduate of the University of Pennsylvania with a Ph.D. degree.

Alan R. Hurst, Technical Sales, Hercules Powder Co., Wilmington, Del., a 1949 graduate of the University of Rochester.

Arturs J. Jankauskis, Technical Assistant, Industrial de Papel Leon Feffer S/A, Sao Paulo, Brazil, a 1932 graduate of the University of Latvia.

Joseph G. Jarrell, Technical Representative, Hercules Powder Co., Wilmington, Del., a 1948 graduate of the University of Delaware.

R. Harold Jenkins, Jr., Technical Sales, Hercules Powder Co., Wilmington, Del., a 1947 graduate of the University of Tennessee.

Ola A. Kaustinen, Technical Associate, The Institute of Paper Chemistry, Appleton, Wis., a 1947 graduate of the Finland Institute of Technology.

John E. Keough, Technical Service Representative, Hercules Powder Co., Atlanta, Ga., a 1948 graduate of the University of Massachusetts.

Frederick T. King, Field Service Engineer, National Starch Products, Inc., New York, N. Y., a 1949 graduate of Ohio Wesleyan University.

Jaroslav Kudera, Manager, Tvornica Sulphate Cellulose & Kraft Paper Mfrs., Maglaj, Yugoslavia.

Kensuke Kudoh, Lecturer, Nihon University, Tokyo, Japan, a graduate of the Tokyo University.

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Luigi Merlo, Director, Industrial Development Laboratory, Montecatini, Milano, Italy, a 1926 graduate of the University of Turin with a Ph.D. degree.

Arthur R. Merritt, Jr., Special Representative, The Goodyear Tire & Rubber Co., Chemical Div., Akron, Ohio, a 1948 graduate of Yale University.

Byron C. Miller, Superintendent, Pulp Mill, P. H. Glatfelter Co., Spring Grove, Pa., a 1943 graduate of Gettysburg College.

Stanley M. Miller, Corrugator Superintendent, Connelly Containers, Pencoyd, Pa.

Ralph D. Mosher, Chemical Engineer, Minnesota & Ontario Paper Co., International Falls, Minn., a 1947 graduate of the University of Toronto.

Paul E. Mullins, Project Engineer, Pusey & Jones Corp., Wilmington, Del., a 1950 graduate of the University of Delaware.

Humphrey D. Murray, Technical Director, Ozalid Co. Ltd., Loughton, Essex, England, a graduate of Oxford University.

Tore H. Nevrell, Technical Manager, A/B Billingsfors-Langed, Billingfors, Sweden, a graduate of the Royal Institute of Technology, Stockholm.

Harold W. Peck, Plant Engineer, P. J. Schweitzer, Inc., Elizabeth, N. J., a 1930 graduate of Renssalaer Polytechnic Institute.

Robert R. Peck, Senior Research Chemist, Oxford Paper Co., Rumford, Me., a 1951 graduate of New York State College of Forestry.

Virgil E. Perry, Plant Engineer, The Harding-Jones Paper Co., Excello, Ohio.

William Pittam, Plant Engineer, Weyerhaeuser Timber Co., Pulp Div., Springfield, Ore., a 1938 graduate of Oregon State College.

Ugo Poggianti, Chemical Engineer, Cellulosa d'Italia S.p.A., Rome, Italy, a 1935 graduate of the University of Naples.

S. Kepple Pratt, Technical Assistant to the Mill Manager, St. Regis Paper Co., Jacksonville, Fla., a 1947 graduate of Carnegie Institute of Technology.

Carl Raaka, Research Assistant, Shell Chemical Corp., New York, N. Y., a 1947 graduate of University of California.

Malcolm J. Reider, Industrial Consultant, Shillington, Pa., a 1941 graduate of Columbia University with a Ph.D. degree.

Robert W. Reigers, Group Leader, Champion Paper & Fibre Co., Hamilton, Ohio. Attended Miami University.

Lawrence E. Robinson, Student, University of Maine, Orono, Me.

M. Rossignol, Director of Plant Research, Solvay & Co., Brussels, Belgium.

George W. Rothmyer, Chemist, Fibre Leather Mfg. Corp., New Bedford, Mass.

Earl W. Scott, Jr., Sales Service, Goodyear Tire & Rubber Co., Inc., Chemical Div., Akron, Ohio, a 1942 graduate of the University of Wisconsin.

William J. Shaughnessy, Service Engineer Trainee, Albany Felt Co., Albany, N. Y., a 1954 graduate of the New York State College of Forestry.

William G. Sheard, Director of Research and Development, General Container Corp., Cleveland, Ohio, a 1949 graduate of Case Institute of Technology.

Alfred L. Skinner, Research Chemist, Ecusta Paper Corp., Pisgah Forest, N. C., a 1941 graduate of Duke University.

Robert L. Smith, Chemical Engineer, S. D. Warren Co., Cumberland Mills, Me., a 1934 graduate of Brown University.

Robert J. Stevens, General Control Superintendent, Pulp Div., Canadian International Paper Co., Montreal, P. Q., Canada, a 1938 graduate of the University of Toronto.

George L. Swallow, Project Engineer, Johns-Manville Corp., Manville, N. J., a 1943 graduate of Cornell University.

John M. Swanson, Research Manager, Industrial Products Research, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., a 1937 graduate of Michigan College of Mining and Technology, with a Ph.D. degree from the University of Wisconsin in 1940.

F. Martin Sweets, President, The Martin Sweets Co., Louisville, Ky., a 1935 graduate of Centre College.

Carl R. Swenson, Application Engineer, General Electric Co., Philadelphia, Pa., a 1928 graduate of the University of Washington.

Michael J. Tarantino, Chemist, International Paper Co., S. Glens Falls, N. Y., a 1940 graduate of St. Lawrence University.

Edgar E. Thomas, Executive Engineer, Appleton Machine Co., Appleton, Wis., a 1911 graduate of Bradford Technical College.

Ernest K. Thommen, Graduate Student, University of Maine, Orono, Me., a 1949 graduate of Swiss Federal Institute of Technology.

Harry W. Turner, Research Chemist, Hercules Powder Co., Wilmington, Del., a 1951 graduate of the University of Minnesota.

Erik B. Ungern, Chemical Engineer, Scott Paper Co., Chester, Pa., a graduate of the Technical University, Darmstadt.

John E. Valente, Research Chemist, Kimberly Clark Corp., Neenah, Wis., a 1940 graduate of Roosevelt University, Chicago.

Alden H. Webber, Field Representative, The Bristol Co., Seattle, Wash.

Kurt Wendtner, Librarian, Bowaters Development & Research Ltd., Northfleet, Kent, England, a 1952 graduate of the University of London.

Leonard J. Whittemore, Director of Quality Control, Hankins Container Co., Union, N. J. Attended William and Mary College.

Roy B. Williams, Special Representative, The Goodyear Tire & Rubber Co., Inc. Attended Reed College.

Thomas R. Young, Assistant General Manager, Menasha Container Corp., Anaheim, Calif. Attended the University of Wisconsin.

Tatsuji Yamamoto, Assistant Technologist, Experiment Station, HSPA, Honolulu, T. H., a 1950 graduate of the University of Hawaii.

Frederick L. Ziel, Resident Manager, Crown Zellerbach Corp., Port Townsend, Wash., a 1923 graduate of the University of Washington.

TAPPI Notes

Albert H. Adams, formerly of Bauer Bros. Co., is now with Congoleum-Nairn, Inc., Cedarhurst, Md.

Clarence H. Anderson, Project Engineer for Chas. T. Main, Inc., has been transferred from Boston, Mass., to Everett, Wash.

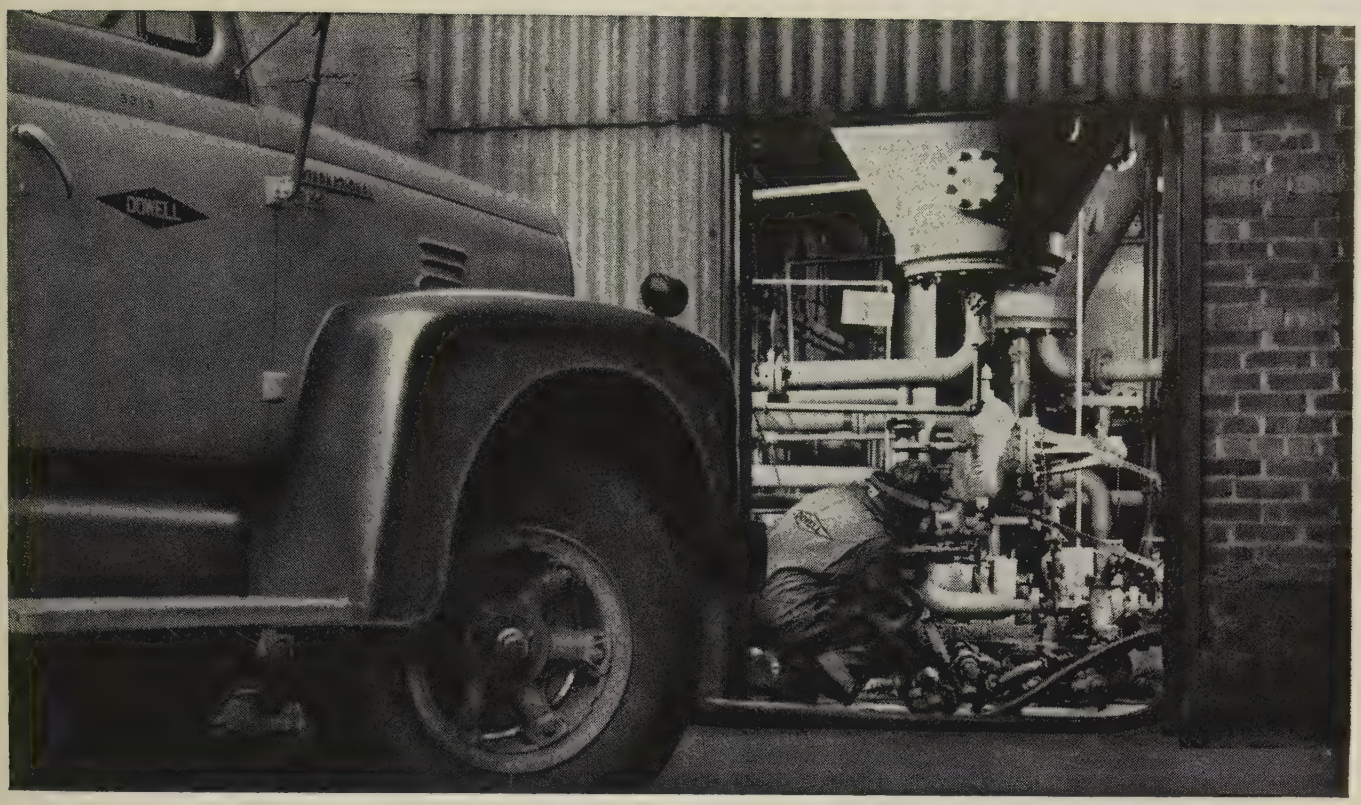
William T. Bennett, formerly Assistant Mill Manager of the Smith Paper Division, Peter J. Schweitzer, Inc., is now with the Brown Paper Co. (CICSSA), Montevideo, Uruguay.

John C. Benny is now General Superintendent of the Diamond Match Co. Paper Mill, Ogdensburg, N. Y.

Harold Bice, formerly with du Pont, is now a Chemical Engineer at the Indiana Ordnance Works, Charleston, Ind.

Harry M. Burnette, formerly of the National Container Corp., is now Maintenance Superintendent for the Champion Paper & Fibre Co., Pasadena, Texas.

L. V. Burton has retired as Executive Director of the Packaging Institute, New York, N. Y., but will remain on the staff



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Production in this paper mill had to be slowed down because pulp deposits reduced the capacity of an 875-foot slurry line. The scale, averaging 1½ inches thick, in effect had changed the 8-inch diameter line into a 5-inch one.

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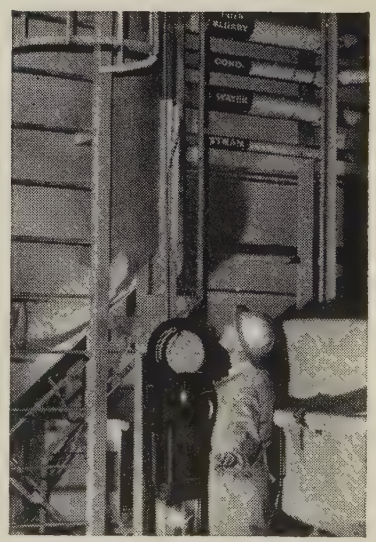

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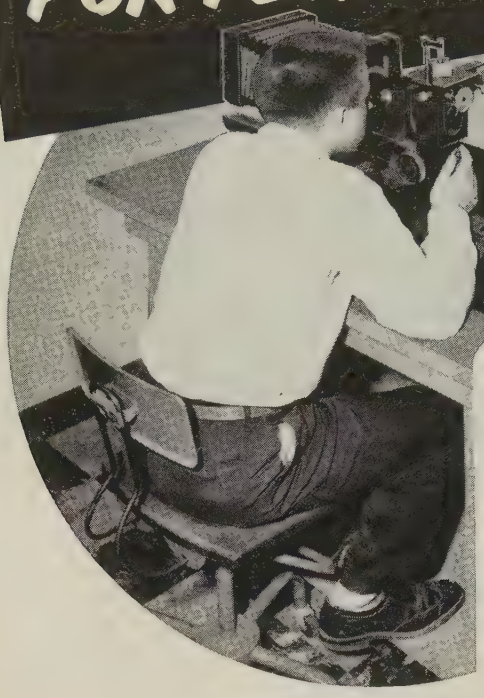

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as a part-time consultant. He is succeeded as Director by Charles A. Feld.

Dan B. Chapman, formerly of Morden Machines, Inc., is now a Manufacturer's Representative in Appleton, Wis., representing Morden Machines, Cherney Bigelow Wire Works, W. P. Evans and Fulton Iron Works.

C. T. Clark, formerly of Restigouche Co. Ltd., is now Mill Manager of Fraser Companies Ltd., Edmundston, N. B., Canada.

Per H. Collins, formerly of Stora Kopparberg, Berlags A/B, is now Works Manager for A/B Svenska Metallverken, Vasteras, Sweden.

Harold E. Cunningham is now Vice-President and Manager of the Dominion Engineering Works, Montreal, P. Q., Canada.

Warren F. Daniel is now Manager of Engineering, Great Northern Paper Co., Millinocket, Me.

Arnold J. Drapeau, formerly student at Laval University, is now a supervisor for Merck & Co. Ltd., Valleyfield, P. Q., Canada.

L. G. Durant, formerly with Pandia, Inc., has organized a new company, Condi Engineering Co., Pittsfield, Mass.

Edwin F. Fisher, Jr., formerly of Gilbert Paper Co., is now Research Engineer for the Nekoosa Edwards Paper Co., Port Edwards, Wis.

Louis E. Georgevitz, formerly of Titanium Pigment Co., is now with The Borden Co., Bainbridge, N. Y.

Herbert Habiger, formerly with Franz Mayr-Melnhof A/G, is now Research Engineer for Nicolaus G.m.b.H. Centrallaboratory, Kempten, Allgau, W. Germany.

Paul L. Haggerty is now Technical Director and Assistant Superintendent of George LaMonte & Son, Nutley, N. J.

Arne Hallencreutz, formerly of Svenska Flakfabrikken, is now President of American SF Products, Inc., New York, N. Y.

F. R. Hamilton is now General Superintendent of the Everett Pulp & Paper Co., Everett, Wash.

Walker Hamilton, Jr., formerly of the Oxford Paper Co., is now a salesman for the Oxford Paper Co., New York, N. Y.

Gerald Haywood is now Technical Assistant to the Director of Technological Research and Development, West Virginia Pulp & Paper Co., Luke, Md.

Herbert S. Heide is now with the Council for Scientific and Industrial Research, Praetoria, South Africa.

William Herbert is now Superintendent of Engineering, Insulating Board and Felt Mills, Barrett Division, Allied Chem. & Dye Corp., New York, N. Y.

Milton A. Hescock, formerly of the Brown Co., is now a pulp salesman for Riordon Sales Corp. Ltd., New York, N. Y.

John H. Heuer is now Manager of Research and Control for the Great Northern Paper Co., Millinocket, Me.

James H. Hull, of the Crown Zellerbach Corp., has been transferred from Camas, Wash., to Seattle, Wash., as Chemical Engineering Specialist in the central engineering office.

William Y. Irwin, formerly of Congoleum-Nairn, Inc., is now Director of Research and Development for Bauer Bros. Co., Springfield, Ohio.

Harold M. Johnston has resigned his position as Sales Manager for the Starch Division of General Mills, Inc., Minneapolis, Minn. He was formerly associated with Stein, Hall, & Co.

Frank Kaulakis, formerly of Clinton Foods, Inc., is now Chief of Coating Development for the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

Charles Kelly, Jr., formerly of H. Waterbury & Sons Co., is now a sales representative for McClusky Wire Co., Inc.. New Haven Conn.

David J. Kraski, formerly of the Oxford Paper Co., is now a student at the Institute of Paper Chemistry, Appleton, Wis.

Robert H. Lace, formerly of the Lincoln Paper Co., is now Technical Director for the Riverside Paper Corp., Appleton, Wis.

Daniel V. Lent, formerly with W. R. Grace Co., is now Chemist for the Alton Box Board Co., Carlyle, Ill.

John G. Leech is now Director of the Research Laboratory, West Virginia Pulp & Paper Co., Luke, Md.

Arthur E. Levansailor, of the Great Northern Paper Co., has transferred from Madison, Me., to East Millinocket, Me., as Assistant Mill Superintendent.

Bernard M. Malkin is now a consultant for the Dominion Engineering Co. at Waterloo, Ont.

Thomas F. Martin, Jr., is now General Superintendent of the Hartford City Paper Co., Hartford City, Ind.

Kon Matchuk, formerly of the Maxwell Paper Co., is now Assistant Superintendent of the Chillicothe Paper Co., Chillicothe, Ohio.

Robert G. MacKay is now Assistant Mill Superintendent of the Great Northern Paper Co., East Millinocket, Me.

James A. McLean is now Superintendent of the Great Northern Paper Co., Millinocket, Me.

Ralph T. Nazzaro is now Vice-President in Charge of Research for the Westfield River Paper Co., Russell, Mass.

Bjon A. Nelson, formerly of Pagel, Horton Co., is now Engineer for Mo och Domsjo Co., Stockholm, Sweden.

L. D. Nicolson, formerly of the National Vulcanized Fibre Co., is now President of the Michigan Paper Co., Plainwell, Mich.

Clifford Patch, Technical Director of the Eastern Corp., Bangor, Me., was honored at the University of Maine alumni luncheon in New York during TAPPI Week by being presented the U. of Maine Pulp and Paper Foundation Honor Award.

Howard W. Rowan, Jr., formerly of Sitroux, Inc., is now Plant Manager of Doeskin Products, Inc., Wheelwright, Mass.

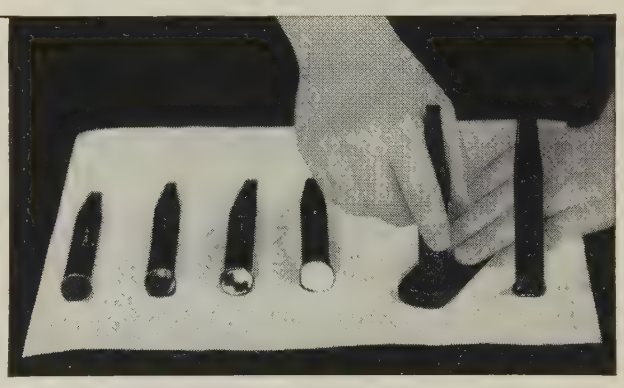
Warren S. Rushton, formerly student at Lowell Technological Institute, is now Assistant Plant Manager for McLaurin-Jones Co., Brookfield, Mass.

Paul K. Schilling, formerly of Keyes Fibre Co., is now with Plastics, Inc., St. Paul, Minn.

George R. Seviour, formerly with Canadian Resins & Chemicals Ltd., is now Mechanical Engineer for West Virginia Pulp & Paper Co., Charleston, S. C.

Daniel T. Snell, Chemical Engineer for Robert Gair Co.,

"Laboratory in a box" pre-tests printing papers



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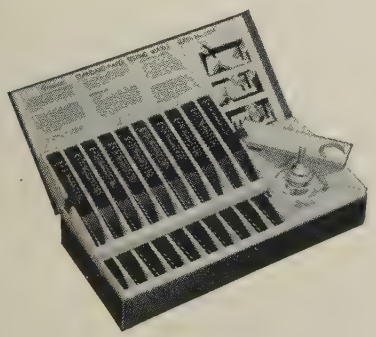

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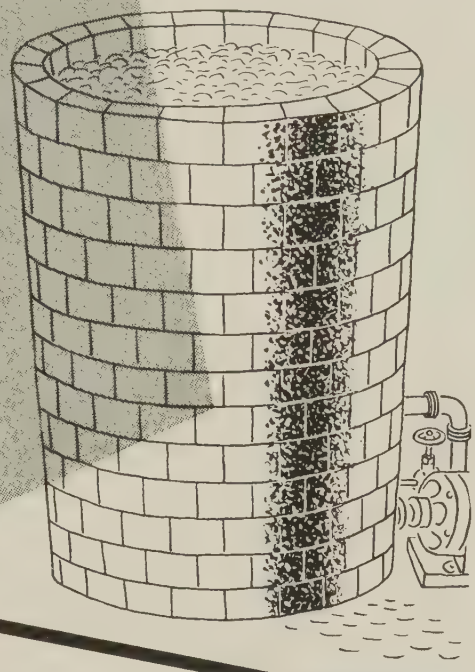

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FREE publications of interest to the paper industry:

- "Silicate of Soda in Paper Making"... Bulletin No. 6-1
- "Sorption of Sodium Silicate and Silica Sols by Cellulose Fibres"... No. 17-27
- "Coating Paper with PQ Sodium Silicate"... Bulletin No. 15-1
- "Treatment of Raw and Waste Waters with PQ Silicates"... Bulletin No. 52-19
- "Stixso Adhesive Processes for Quality Corrugated Paper Board"... Bulletin No. 12-21

PHILADELPHIA QUARTZ COMPANY
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has been transferred to the Angelus Paper Box Co. Division, Los Angeles, Calif.

Norton L. Speck, formerly of the Individual Drinking Cup Co., is now Director of Quality Control for the Solo Cup Co., Chicago, Ill.

Fred B. Speyer, formerly of Pierce & Stevens, Inc., is now Research Chemist for Brece Chemicals, Inc., Brea, Calif.

Warren B. Stanton is now Assistant to the Manager, New Products-Organic Chemicals Dept., Wyandotte Chemicals Corp., Wyandotte, Mich.

Howard W. Stephen is now Pulp Mill Superintendent for the National Container Corp., Big Island, Va.

J. P. Strasser is now Vice-President of Morningstar Nicol, Co., New York, N. Y.

Charles R. Tittemore, formerly of Gaspesia Sulphite Co. Ltd., is now Assistant General Superintendent of Anglo-Canadian Development Co., Grand Falls, Nfld., Canada.

J. J. Thomas is now Associate Research Director of S. D. Warren Co., Cumberland Mills, Me.

Ralph N. Thompson is now Manager of Research for Calgon, Inc., Pittsburgh, Pa.

G. Gordon White, formerly of A. E. Staley Mfg. Co., is now with Typer Rubber Co., Andover, Mass.

J. C. Wollwage is now Associate Manager of the Market Research and Products Division, Kimberly-Clark Co., Neenah, Wis.

Hugo G. Zwecker, formerly of Papierfabrik Wattens, Austria, is now with the J. O. Ross Engineering Co., Los Angeles, Calif.

* * *

F. H. Goyette, Chief Engineer, has succeeded C. S. Connington as the official representative of the Lodding Engineering Co. in the Technical Association.

Cliff R. Crawford, President, has succeeded H. D. Martindale as the official representative of the Black-Clawson Co. in TAPPI.

W. A. White, General Manager, has succeeded Abe Cooper as the official representative of the Bagley & Sewall Division in TAPPI.

Tany Agronini, General Manager, has succeeded A. Whittemore as the official representative of Pandia Division in TAPPI.

Kenneth C. Johnson, Technical Manager, has succeeded C. F. Schaumann, retired as the official representative of E. I. du Pont de Nemours & Co., Inc., in the Technical Association.

* * *

Note: The 1955–56 TAPPI Year Book is being prepared for publication. Members of the Technical Association of the Pulp and Paper Industry are urged to advise the central office, 155 E. 44th St., New York 17, N. Y., about any errors appearing in the 1954–55 Year Book so that corrections can be made.

Industry Notes

PRODUCTION

Despite a decline in general industrial activity in 1954, the paper industry produced an estimated 26,613,000 tons last year. Thus, for the third time in four years a new production record was established and the stability and growing importance of this dynamic industry to our national economy were again demonstrated. Further, it should be pointed out that the foregoing estimate of production may prove to have been conservative when differences between data reported by the Bureau of the Census and the National Paperboard Association have been reconciled.

In achieving this record, the production of paper, led by newsprint, tissue, and building paper approximated 13,018,000 tons. This was 2.4% more than in 1953 and slightly in

excess of the previous high, 13,010,418, established in 1951. Although the production of paperboard, including building board, estimated on the basis of Census data to have been 13,595,252 tons, was 1% less than in 1953, it was the strong resurgence in the latter part of the year by this segment of the industry that raised production to a new height and enabled it to conclude the year on a note stronger than that of any of the preceding years.

The December output of printing papers (book and groundwood) was high despite the holiday season, and is estimated to have been 322,000 tons. This was 6% more than in November and approximated the year-peak of 322,188 tons achieved in March. As a result, production for the year is estimated to have been 3,613,916 tons, about 1% more than last year and a new annual high. The volume of new orders received during the month was 351,000 tons, raising the backlog of unshipped orders to 324,000 tons, 5% more than at the close of 1953.

The production of fine papers amounted to 112,000 tons for the month, 3% less than in November, but above the monthly average of 110,000 tons for the year. Production for the full year is estimated to have been 1,318,000 tons. This was 2% more than in 1953 and second only to the 1,366,000 tons made in 1951 when, due to the emergency, Government shipments were substantially higher than in the past year. If the 1954 volume of such shipments had equalled that of 1951, a record production of fine paper would have resulted, indicating that in the interim there has been an increase in the volume of commercial shipments by fine paper mills.

The coarse paper segment of the industry continued to produce at a satisfactory rate in December as output for the month amounted to an estimated 288,000 tons. Although shipments were 4000 tons in excess of production, this was offset by an increase in the volume of new orders, causing the backlog of unshipped orders to continue at 133,000 tons, approximately 10% more than at the end of 1953. For the year, production was 3,437,480 tons, 1% more than in 1953, but 5% less than the record year of 1951 when 3,627,000 tons were manufactured.

Tissue paper, which enjoys the fastest rate of annual growth among the major paper groupings, continued its upward movement as the 126,000 tons estimated to have been produced during December raised the total for the year to 1,569,117 tons, 4% more than in 1953. The sustained and rapid growth in the manufacture of these papers is well illustrated by the fact that since 1946 production has on only one occasion, 1952, failed to exceed that of the preceding year. During that period the output of these papers has risen from 1,044,495 to 1,569,117 tons, a growth equal to about 50%.

In 1954 the production of newsprint, which only ten years ago had fallen to a low of 721,000 tons, continued its steady march toward the mid-twenties peak as 1,211,156 tons were manufactured. This was an increase of 11.7% over the tonnage produced in 1953. The combined production for the United States and Canada was 7,168,308 tons, 5.3% above 1953, and 4.9% above 1952, the previous record year.

Paperboard production, wherein the previously indicated difference exists between data of the Bureau of the Census and National Paperboard Association, in 1954 is estimated to have been 12,081,355 tons, about 2.4% less than in 1953. It is noteworthy that this segment of the industry, after trailing its 1953 performance by about 4% as recently as September, shared in the Fall recovery to an extent that enabled it to substantially reduce that deficiency by the end of the year.

Pulpwood

Pulpwood receipts in November, 1954 totaled 2,524,000 cords and for the January–November period were 25,919,000 cords, an increase of 308,000 cords over the comparative period in 1953. Domestic receipts increased 224,000 cords

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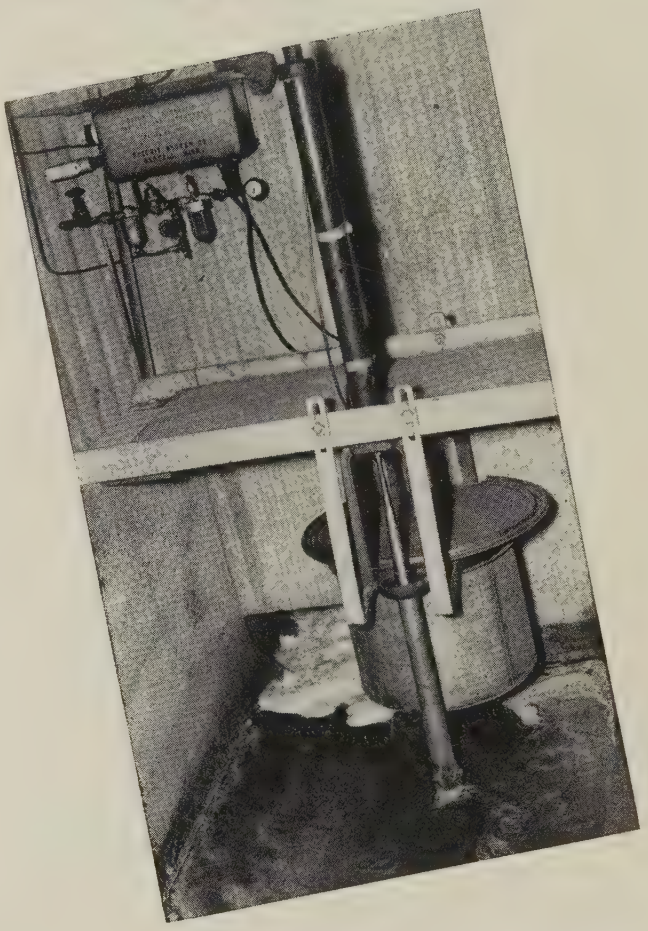

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Estimated Production

	1954	1953	1952	1951
Group				
A—Printing and similar papers	3,614,000	+1.1	+6.8	+2.8
B—Fine papers	1,318,000	+2.2	+1.8	−3.6
C—Coarse papers	3,437,000	+1.1	+6.1	−5.2
D—Tissue papers	1,569,000	+4.0	+15.6	+6.5
E—Miscellaneous papers	526,000	−4.9	+2.3	−1.9
F—Total groups A–E	10,464,000	+1.3	+6.9	−0.5
Newsprint	1,190,000	+11.3	+7.3	+7.4
Building paper	1,364,000	+3.9	+5.0	−1.6
Total Paper	13,018,000	+2.4	+6.7	+0.1
Paperboard	12,081,000	−2.4	+10.7	+2.7
Building board	1,514,000	+10.0	+15.1	+19.3
Total Board	13,595,000	−1.1	+11.1	+4.3
Total Paper and Board	26,613,000	+0.6	+9.0	+2.2

and imports were up 84,000 cords. Regionally, the Northeast showed a decline of 244,000 cords, the Appalachian and the South remained the same, and the Lake States and Pacific Northwest showed increases of 160,000 cords and 435,000 cords, respectively.

Consumption in November continued high, 2,550,000 cords having been reported, and for the 11-month period, 26,743,000 cords were consumed. In comparison to 1953 for the same period, this was an increase of 795,000 cords. Minor decreases were reported in the Northeast and Lake States regions, while the largest increase was reported in the Pacific Northwest, 640,000 cords. Inventories at the end of November were 4,823,000 cords, a decline of 759,000 cords from inventories at the end of November, 1953.

Wood Pulp

Indicative of the high paper and board production and increased exports, wood pulp production in November continued at a peak rate. Production for that month was 1,598,000 tons, the second highest on record, and for the 11 months totaled 16,691,000 tons, an increase of over a half a million tons above production for the comparable months in 1953.

Wood pulp consumption in November, 1,648,000 tons, was the third highest recorded, and for the 11-month period, January through November last year, totaled 17,365,000 tons, an increase of 146,000 tons over the comparable period in 1953.

Overseas imports of wood pulp in 1954 through November amounted to 341,000 tons, a decline of 157,000 tons from the level of imports for the comparable months in 1953. On the other hand, imports from Canada for this same period increased from 1,483,000 tons to 1,540,000 tons over 1953. Due to the decline in imports from Europe, however, total imports were down about 100,000 tons.

Exports of wood pulp increased so much last year, that by the end of November they had reached 382,000 tons, almost three times the amount exported in the January–November period in 1953. The gap between wood pulp exports and imports from overseas widened in November, and for the January–November period exports exceeded overseas imports by over 40,000 tons.

Inventories during November increased appreciably, totaling 702,000 tons by the end of the month, an increase of 34,000 tons over October and an increase of 54,000 tons over inventories at the end of November, 1953. Inventories at pulp mills at the end of November were 185,000 tons, and at paper and board mills 517,000 tons.

Wastepaper

In 1946, the first year after the end of World War II, in the production of 19,278,000 tons of paper and paperboard, the mills of the United States consumed 12,092,000 tons of wood pulp and 7,278,000 tons of wastepaper.

In 1954, the year just closed, the total production of paper and board had risen to 26,656,631 tons, an increase of 38.2% over 1946. In producing this great tonnage of paper and board last year, the nation's mills consumed 19,033,994 tons of wood pulp, an increase of 57.4% over the consumption of 1946, and 8,063,582 tons of wastepaper, an increase of 10.8% over 1946. All figures given above are for short tons as reported by the Bureau of the Census.

A recent editorial in the *Daily Mill Stock Reporter* suggests that wastepaper dealers will have to supply better quality stock if they wish to share in the prosperity that is predicted for the paper industry in the immediate future. The carelessness of some shippers during the Korean period, when both waste paper and wood pulp was scarce, has resulted in a gradual changeover to wood pulp in preference to wastepaper.

United States Imports of Wood Pulp—By Country of Origin

(In short tons, January–December, 1954)

Grade	Total world	Canada	Total Europe	Sweden	Finland	Norway	Austria	France	West Germany	Portugal
Sulphite	858,198	740,541	117,647	69,259	35,066	13,275	...	22	...	25
Rayon and special	230,384	228,143	2,241	1,084	11	1,146	...	...	...	..
Other bleached	288,396	246,441	41,955	26,379	3,447	12,129	...	...	...	..
Unbleached	339,418	265,957	73,451	41,796	31,608	...	...	22	...	25
Sulphate	907,045	693,866	213,179	135,515	77,031	605	...	28	...	..
Bleached	637,193	541,484	95,709	95,076	...	605	...	28	...	..
Semi-bleached	24,584	11,324	13,260	3,564	9,696	...	...	...	...	..
Unbleached	245,268	141,058	104,210	36,875	67,335	...	...	...	...	..
Soda	37,936	37,936	...	...	...	...	...	...	.....	..
Groundwood	236,561	199,228	37,328	16,257	19,954	1,117	...	...	...	..
Bleached	62,830	51,253	11,572	10,489	570	513	...	...	...	..
Unbleached	173,731	147,975	25,756	5,768	19,384	604	...	...	...	..
Screenings	11,020	6,839	4,181	3,440	741	...	...	...	...	..
Chemical	7,076	3,731	3,345	2,604	741	...	...	...	...	..
Mechanical	3,944	3,108	836	836	...	...	...	...	...	..
1954 (Jan.–Dec.)	2,050,760	1,678,410	372,335	224,471	132,792	14,997	...	50	...	25
1953 (Jan.–Dec.)	2,157,574	1,613,665	543,909	336,158	160,216	36,519	10,217	211	588	..
Per cent change	−5	+4	−32	−33	−17	−59	...	−76	...	..

Even with the additional cost involved in supplying higher grade stock, wastepaper will still be cheaper than wood pulp and the mills will accept it if they can depend on getting good quality.

Newsprint Consumption

In 1953 the world (except U.S.S.R. and China) produced about 9560 thousand metric tons of newsprint. In the same year the principal consuming countries were the United States with 5467 thousand metric tons, the United Kingdom with 723 thousand metric tons, Japan with 414 thousand metric tons, and France with 370 thousand metric tons. United States newsprint consumption in 1953 represented an increase of 69% over prewar (1935–39 average) whereas the United Kingdom's 1953 newsprint consumption, although appreciably higher than in the earlier postwar years, fell short of the prewar average by not less than 42%.

Per capita consumption of newsprint before the war (1935–39 average) was highest in the United Kingdom (26.4 kilos), followed by the United States (25.1 kilos), Australia (24.3 kilos), New Zealand (21.0 kilos), Canada (15.8 kilos), Denmark (13.9 kilos), and Sweden (13.8 kilos). In 1953, newsprint consumption per capita amounted to 34.2 kilos in the United States, to 21.9 kilos in Canada, and to 18.3 kilos in Sweden while in the United Kingdom it was down to 14.2 kilos or little more than half the prewar average.

In 1952 (latest year shown for most countries) the circulation of daily newspapers per 1000 inhabitants was easily highest in the United Kingdom (615 copies) where the size of the dailies had been drastically cut as compared to prewar to meet the fall in newsprint supplies, followed by Sweden (490 copies) and Luxembourg (447 copies). The United States is shown to have had a circulation of 346 copies per 1000 inhabitants in 1954. Attention is drawn to the fact that these daily newspapers may range in size according to the country from a single sheet to 50 or more pages (e.g., as in the United States).

—from the "UN Statistical Yearbook."

India

Expected to begin production shortly is India's first newsprint mill. Ebasco Services, Inc., New York, N. Y., designed and supervised construction of the new mill, which was built for the National Newsprint & Paper Co., Ltd., of Bombay. It is located in a woodland area at Chandni in Central India, along the Bombay-Delhi Railroad, some 325 miles northeast of Bombay.

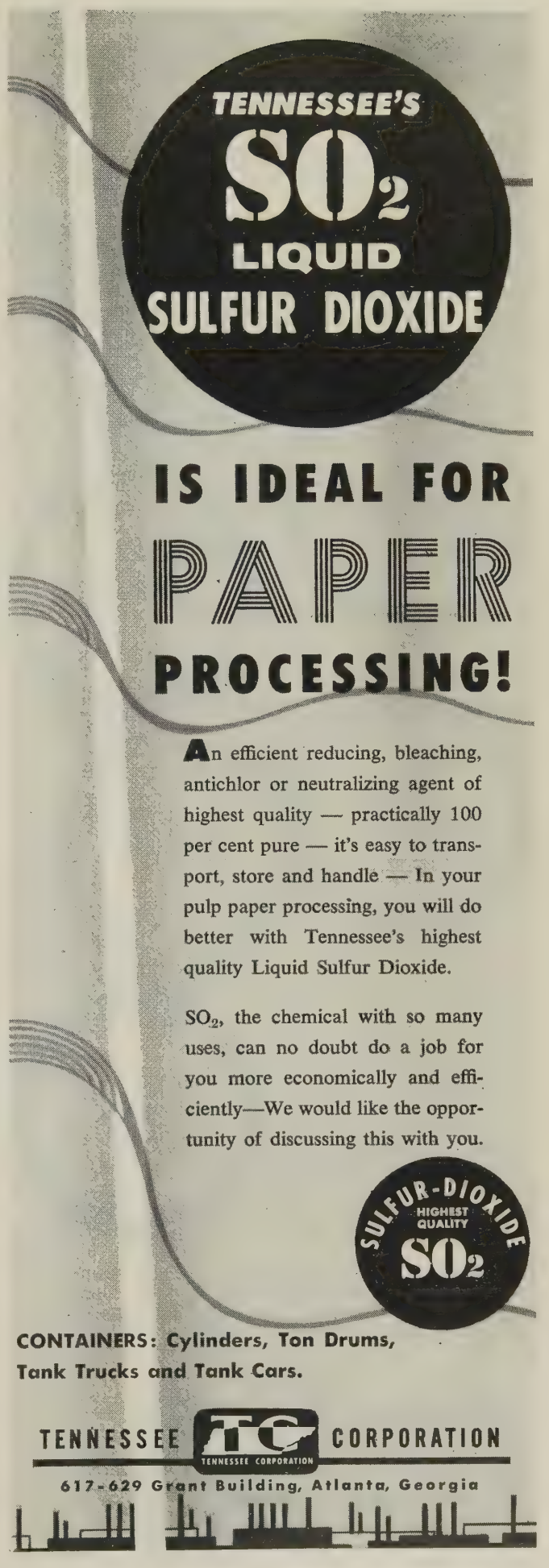
The $12,000,000 project marks the first such enterprise on the mainland of Asia and the only modern one in the world designed and constructed to process newsprint for the first time commercially from bamboo and salai trees. Wood is scarce in India, but there is an adequate supply of the native wood called salai and approximately 11,000 square miles of salai timberlands are immediately available in the Central Provinces for a nearby, continuous supply of resources.

Prime purposes of the new mill is to meet the acute shortages of newsprint and to conserve dollar exchanges of India. The project also represents one of India's first postwar industrial projects and is an essential part of the over-all industrialization plans of that country.

Ebasco Services initially entered the project back in 1948, and at that time the Nepa Mill, as the India newsprint enterprise is known, was slated for full operations at the close of 1950. However, numerous obstacles cropped up constantly, with the result that the target date was forcibly moved back several times.

The lack of foreign exchange was the big stumbling block, according to C. A. Harwick, Ebasco's manager of industrial engineering, who has spent much time at the mill in an effort to speed up its construction.

This lack of foreign exchange compelled the use of manual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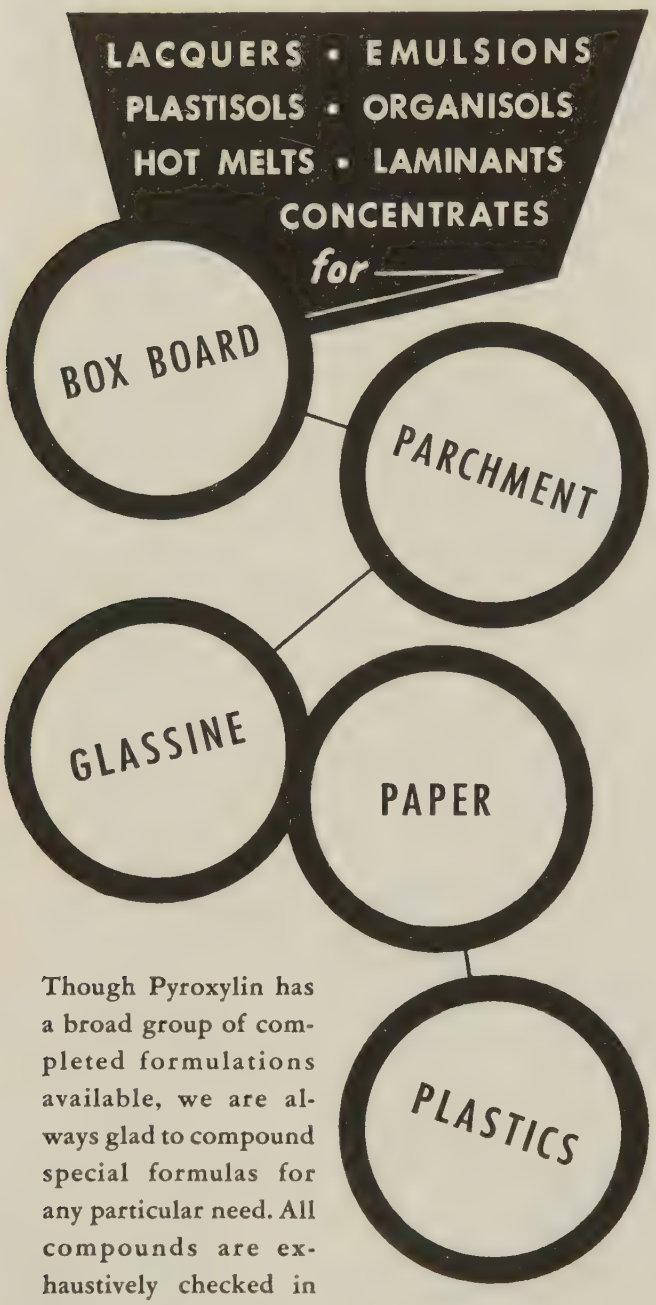

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labor in many instances where one bulldozer could have shortened these jobs to only a few minutes duration. Exorbitant costs of oil and gasoline also precluded use of bulldozers on many occasions. Other deterrents included language difficulties, hazards presented by the many jungle beasts which abound in the area, and the muddy monsoon season that starts in mid-June and virtually halts all traffic for over two months.

However, the many difficulties have at last been overcome and the unique newsprint mill is now ready for operations. Its anticipated annual output of about 35,000 tons of newsprint is expected to go a long way toward relieving the paucity of that vital commodity in India. Previously, Indian newspapers were forced to import their newsprint from Canada or Scandinavia, and schoolbooks had to be printed in other countries, all at great cost.

Japan

The Bank of Tokyo has reported that markets for Japanese pulp have expanded in Pakistan, India, Argentine, Brazil, England, Australia, Mexico, West Germany, and Communist China.

Finland

The new newsprint mill at Kaipola of the Yhtyneet Paperitehtaat O/Y (United Paper Mills Co.) began working in September, at first with an American machine of 70,000 tons capacity; a second machine of British make and a capacity of 50,000 tons is expected to be ready for work in 1955. The Enzo-Gutzeit O/Y new newsprint mill at Summa, near Fredrikshamn, is expected to be put to work this month, and will in the first stage (with an American Beloit machine) have an annual capacity of 80,000 tons.

In regard to newsprint capacity it is stated that this was about 440,000 tons per annum in the immediate postwar years.

When the mills, now building, are ready to start work in the course of 1955, the newsprint output will be increased by about 200,000 tons per annum.

New Hampshire

A bill has been introduced in the New Hampshire legislature (H.B. 43) which proposes that upon classification as reforestation land, the land would be exempt from property tax and the owner would instead pay a forest fee. The Bare Land Tax would have a ceiling of $3.00 an acre if the land is classified as forest land.

Minnesota

Minnesota H.B. 806 would impose a privilege tax on persons handling or dealing in timber or timber products, based on the quantity of timber or timber products severed, as follows: for white pine logs, of grade 4 or better, $1.00 per 1000 board feet; for poles and piling, 4% of the market or delivered sales price; for spruce pulpwood, 40 cents per standard cord; for balsam pulpwood 30 cents per standard cord; for all other species of pulpwood 25 cents per standard cord, and for all other timber and timber products not specified 50 cents per 1000 ft., board measure. The tax would be due in quarterly installments on the first day of April, July, October, and January. H.B. 806 would exempt after Dec. 31, 1955, all growing standing timber, trees, and shrubs from ad valorem taxes.

Arkansas

Last Labor Day week end the worst forest fire in Arkansas history blackened nearly 10,000 acres of timberland near Arkadelphia.

It was a disheartening loss to landowners and struck the region's economy a staggering blow.

The Arkadelphia Chamber of Commerce estimated the timberland would have provided an annual payroll of at least

$75,000 for hauling and harvesting the annual growth. The chamber estimated that salaries and wages to workmen for carrying the wood through to finished products would have topped $260,000 each year.

Today the charred hillsides are coming back to life. Crews are planting millions of little green seedlings. It will take time, but eventually the area will be back in timber production.

Fire-ravaged trees are being salvaged and made into useful products, rather than left in the woods to rot and provide fuel for more fires.

Every logging contractor and forest industry in the area is cooperating to harvest and process the wood before it becomes useless from decay. Spearheading the restoration program are the International Paper Co., Camden, and Ozan Lumber Co., Prescott, heaviest losers from the burn. By the end of the planting season in March, they hope to complete the salvage of fire-killed trees on some 6000 acres and to finish replanting on some 2400 acres. Other land owners within the "burn" will likely reclaim their acreage before the end of the planting season. Also, more planting may be done next year.

Forest Publications

Published by the Northeastern Forest Experiment Station, Upper Darby, Pa., "Forest Research Notes," No. 41, describes the returns obtained from experimental management of a small white pine woodlot in Maine. The station has published "Forest Statistics," Series Nos. 16 and 17, giving revised statistics for New York Forest Districts Nos. 1 and 7.

Tree Farms

Statistics on the nation's tree farms as of Feb. 1, 1955, are as follows:

	No. of tree farms	*Total acreage*
South	3185	20,938,895
West Coast	246	4,415,430
Western Pine	652	5,693,633
Lake States	747	1,820,583
Central States	391	187,351
Plains	185	40,180
Eastern	659	649,056
Total	6063	33,963,513

American Forest Products Industries, Inc., 1816 N St., N.W., Washington, D. C., has published its 1954 annual report.

Tall Oil Production

Tall oil production in 1954 was about 350 million lb. and the potential was—placed as high as 600 million. About 60 lb. of the crude oil is extracted from each ton of southern pine used in kraft paper mills. Crude tall oil contains about 45% fatty acids, primarily oleic and linoleic acids.

New and projected plants for tall oil processing are in operation or planned by Arizona Chemical, Newport Industries (in production), West Virginia Pulp and Paper (in production), Crosby Chemicals, and Hercules Powder. Fractionated tall oil fatty acids production was placed at over 25 million lb. for 1953. One industry estimate suggests about 30 million for last year, with 1955 capacity of about 90 million annually for low rosin fatty acids, assuming no Hercules production until 1956.

Tall Oil for Resins

The growing acceptance of tall oil by producers of some of the simpler, widely used resins has already been outlined. Bulletin 13* reviewed the polyol esters and Bulletin 14† dealt mainly with alkyds. The present bulletin considers some of

* Published in *Tappi*, April, 1954, p. 116A.
† Published in *Tappi*, December, 1954, p. 108A.

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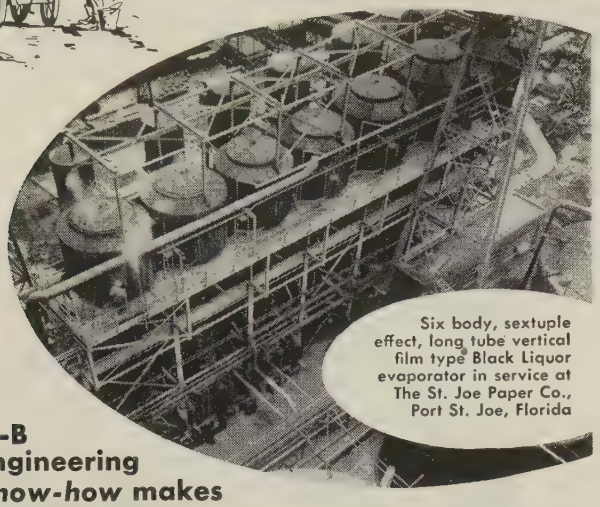

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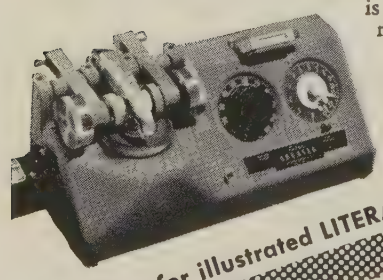

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the more complex resins. Tall oil and its products provide a bright spot in the cost picture of these resins which are generally expensive to make, mainly because their ingredients tend to be expensive. The comparatively steady, modest cost of tall oil and of tall oil products can counteract much of such extra costs and often it is the use of tall oil with more expensive materials that enables the product to become marketable. In the case of oil modified resins the increased functionality of the resin ingredients allows the use of oils of lower functionality which often gives the advantage of greater stability in the product. Consequently, semidrying oils like tall oil and its products can be expected to find additional applications and uses in the protective coatings field.

Phenolic Resins

Compounds of phenolic resins with tall oil products have been in use for many years and have achieved many applications in surface coatings, printing inks, adhesives, binders for flooring, and other surface compositions. Whole (crude) tall oil, refined tall oils, tall oil pitch, tall oil fatty acids, tall oil rosin, and their esters and other modifications are all used.

The presence of phenolic resins in tall oil based coatings and binders greatly improves gloss and gloss retention, the resistance to water and to chemicals such as alkalies, acids, oils, and solvents. The product is more flexible and weather resistant. Its shorter drying time makes it more convenient to use.

Adding tall oil products to phenolic resins improves flexibility and toughness and the comparatively low cost of tall oil permits the extension of phenolic resins to some large volume applications that would otherwise be too costly.

The incorporation of phenolic resins in drying oils first became feasible when it was discovered that the presence of rosin greatly improved the solubility of phenolic resins in drying oils. This development came shortly before World War I and, as tall oil came to be better known, the merits of tall oil both as a drying oil base and as a phenolic resin solubilizer came gradually to be recognized. With the many phenols and aldehydes now available to provide an enormous variety of phenolic resins, and the many grades of tall oils and polyols, new fields of application are constantly developing.

Phenolic resins have as their basis the polymerization of phenols with aldehydes. For use with tall oil and other drying oils the para-substituted phenols are the most important because their resins are more soluble in drying oils and are less likely to discolor than when ordinary phenol is used. The aldehyde most generally used is formaldehyde. Phenolic resins are of two general types, the novolaks and the resols.

Novolaks are available in solid form or in solvent solutions. They are hard, thermoplastic resins which are considered nonreactive but compatible with drying oils like tall oil polyol esters and alkyds. For use they are merely blended with a tall oil base or other drying oils. Novolaks are stable in storage and easy to handle.

Resols can be purchased as viscous, water solutions but they are not as stable on storage as novolaks and large users often prefer to make their own resols. Resols are partially polymerized phenolic resins which react with rosin and with unsaturated fatty acids—the principal constituents of tall oil. Resols are thermosetting and their compounds with rosin, tall oil, or drying oils are heat reactive and air drying.

Resols are made by reacting phenols with aldehydes in the presence of alkalies. Novolaks result when an acid catalyst is used.

The ratio of aldehyde to phenol used greatly affects the nature of the phenolic resin. Thus, acid-catalyzed resins can be made which are reactive with tall oil by using less aldehyde than for a novolak. The product then contains free phenolic hydroxyl groups which may be esterified with the acids of tall oil by heating with or without catalysts.

A typical procedure with resols—and there are many variations—is to add the resol syrup gradually to the tall oil which is held at a temperature of 375°F. or higher. The product is then heated at esterification temperatures, about 550°F., with sufficient polyol to reduce the acid number to the desired degree. Where a sufficiently large proportion of resol is used the addition of polyol may not be necessary since some of the phenolic hydroxyls esterify with the tall oil during heating.

References: 1, 2, 3, 6, 7, 8, 11, 14, 15, 18, 20, 21, 23, 25, 26, 33, 34, 35, 37, 45, 46, 51, 52, 53, 55, 57, 58, 59.

Styrene Resins

Drying oils and modified alkyds based on tall oil are upgraded by processing with styrene. Vehicles so made find increased usefulness in architectural, industrial, and household finishes and in paper coatings.

Styrenated tall oil based drying oils and alkyds combine some of the advantages of polystyrene with those of drying oils and alkyds. Such vehicles can be made to dry in a matter of minutes where desired. They can be made to give tough coatings resistant to weathering and to many chemicals. Paints and varnishes so based have lighter and more stable colors than available with most phenolics. They are not, however, as resistant to wear and to hydrocarbon solvents as phenolic based coatings.

Styrene first came into large scale production during World War II as an ingredient in synthetic rubber and by 1944 styrene production had reached 350 million pounds annually. Today it is over twice this amount and only 40% goes into synthetic rubber, the rest into a wide variety of resins, water emulsion, or latex paints, styrenated drying oils, styrenated polyesters, and many more. The material offers so many potentialities that an annual output of 1000 million pounds is being projected for 1955. Its potential very low cost, already down to 18 cents a pound, is nicely complemented by the low cost of tall oil.

Polystyrene is not sufficiently soluble in drying oils for direct blending. Chemists get around this by polymerizing styrene in the presence of the drying oil. The styrene monomer reacts with the unsaturated places in the drying oil molecules, especially where there are conjugated double bonds or where they can be formed. The rosin and fatty acid molecules are both rich in unsaturated places for reacting with styrene monomer.

In styrenation, the reaction is usually accomplished by slowly adding the volatile styrene—it boils at about 290°F.—to tall oil or its esters or alkyds. This is done in the presence of a catalyst, usually an organic peroxide like benzoyl peroxide. The substitution of homologs like alpha methyl styrene, dipentene, etc., for part of the styrene gives products of greater miscibility with other oils and solvents.

Products are being made with up to 50% of styrene based on the tall oil. Some prefer to styrenate the tall oil ester or the alkyd, others prefer to styrenate the tall oil and then esterify with polyols and dibasic acids. Styrene reacts more rapidly with the rosin acids than with the fatty acids of tall oil and the reaction is also more rapid with blown tall oils. The hardness of the vehicle film increases with the rosin acids content. Styrenation may also be accomplished without a catalyst by refluxing with an excess of styrene or by just higher temperature heating. Various copolymerization techniques have been devised.

Styrene monomer is available from several manufacturers and ample instructions are available for its safe handling and storage.

Tall oil and its products also have other uses in the styrene resin field. Its disproportionated products are useful emulsifiers in copolymerization processes. Tall oil products are also effective as emulsifiers or stabilizers for water dispersed styrene based paints and other latex products.

References: 4, 5, 9, 12, 19, 22, 28, 30, 31, 36, 48, 49, 50, 56.

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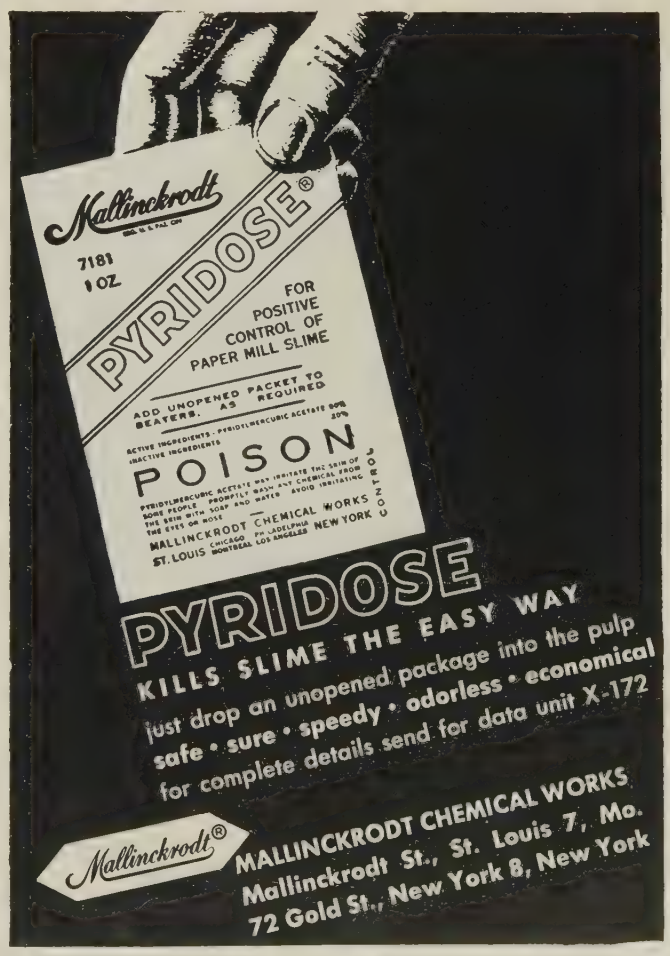
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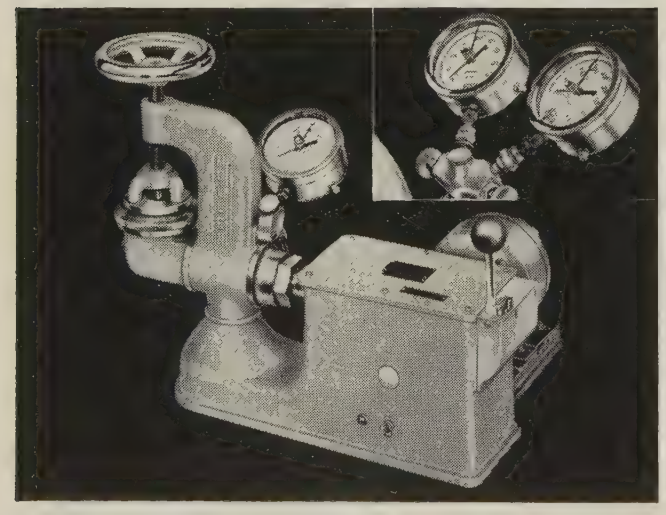

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Vinyl Toluene Resins

The success of styrenated tall oil products led to the investigation of related vinyls; and of these vinyl toluene shows great promise for tall oil based coating resins for interior and exterior paint applications.

Vinyl toluene copolymers of tall oil and of other drying oils are more compatible with drying oils and more soluble in solvents than the styrenated materials, yet provide much the same improvement in drying rates, color, and durability. Vinyl toluene is higher boiling, has a higher flash point, and is more reactive with tall oil and tall oil products.

Vinyl toluene copolymers of tall oil and of other drying oils are so new that their market position cannot yet be predicted. However, it seems likely that there will be a considerable outlet for compounds of this comparatively inexpensive monomer with low cost tall oil.

Up to 60% of vinyl toluene, based on the tall oil, can be satisfactorily copolymerized into desirable coating resins. Commercial vinyl toluene is a mixture of the meta and para isomers boiling at 340°F. It is handled much like styrene. In copolymerizing with tall oil or its products this higher boiling temperature permits a faster reaction rate than with styrene. The formation of incompatible or insoluble homopolymers is further minimized by the use of catalysts of the organic peroxide type. Small amounts—several per cent—of divinyl benzene when used with the vinyl toluene have been found to yield tall oil products of much greater viscosity and of improved chemical resistance and film toughness.

References: 16, 17.

Vinyl Esters

The vinyl esters of tall oil continue to be of great interest but so far little of such esters has come on the market in this country. The vinylation of tall oil and of other drying oils appears to require more investigation before such products can be properly evaluated in the American market.

The comparatively low cost of acetylene—used for vinylation—makes such a product potentially attractive as a way of increasing the functionality or drying and coating qualities of tall oil products. In Germany, where war shortages greatly accelerated the development of acetylene processes, tall oil vinyls came into considerable use but even there the ultimate market position of such products is not yet clear.

Tall oil may be vinylated by mixing it with acetylene gas using catalysts at suitable temperatures. The catalyst generally favored is zinc oxide used to the extent of about 1.5% of the tall oil. This is first heated to form the zinc soaps. An acetylene-nitrogen gas mixture is then passed through with the temperature controlled at 300°F. The vinylation is continued to an acid number of about 20. The product may be heat-bodied and then used as a drying oil either alone or blended with other drying oils and with resins.

Experimentation with acetylene is very hazardous and may be conducted only under rigid safety precautions and until such precautions are better known and understood, acetylene drying oil studies should not be undertaken by the inexperienced.

References: 10, 13, 24, 27, 28, 29, 30, 31, 32, 36, 38, 39, 40, 41, 42, 43, 44, 45, 47, 54, 60, 61, 62, 63.

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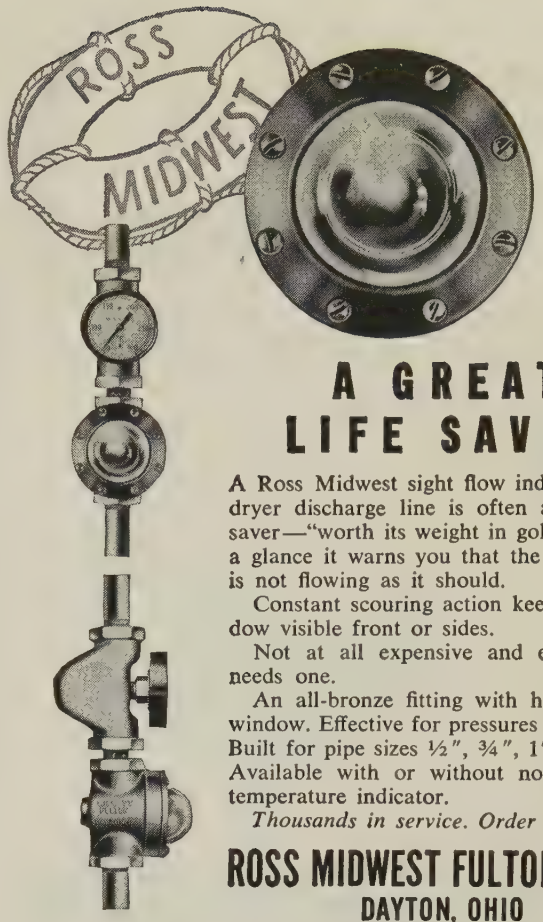

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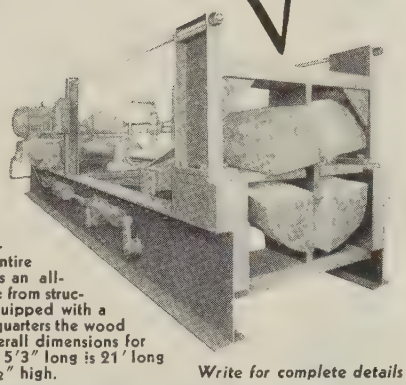

Capacity approximately one log per minute.

Extremely heavy construction to properly support the entire assembly . . . base is an all-welded design made from structural steel . . . equipped with a stationary axe that quarters the wood at one stroke. Overall dimensions for 36" diameter wood 5'3" long is 21' long x 5'2" wide, 5' 8½" high.

Write for complete details

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—from *Bulletin* No. 15, The Tall Oil Association, 122 E. 42nd St., New York, N. Y.

Tree Farms

More farmers are growing trees as a crop than ever before in the nation's history. The industry-sponsored American Tree Farm System reports the greatest progress in its 14-year history occurred during 1954.

A total of 3,573,708 acres of tax-paying woodlands were brought into the American Tree Farm System during the year, bringing the total Tree Farm acreage up to 33,692,964. In announcing these figures James C. McClellan, chief forester for American Forest Products Industries, predicted five million acres will be added to the Tree Farm System in 1955. Mr. McClellan's organization is national coordinator of the program.

Expansion in 1955

The following excerpt, showing pulp and paper expansion projects to be completed in 1955, is taken from *Chemical Week*, Jan. 1, 1955:

Bowaters Southern. Location: Calhoun, Tenn.; capacity: 50,000 tons kraft pulp, 125,000 tons newsprint; value: $51 million.

Dierks Lumber and Coal Co. Location: Southern Arkansas; value: $20 million.

Great Northern Paper Co. Location: East Millinocket, Me.; capacity: 150,000 tons; due in: January, value: $40 million.

Hudson Pulp and Paper Corp. Location: Palatka, Fla.; due in: 1956; value: $15 million.

International Paper Corp. Location: Camden, Ark.; value: $2 million.

Rhinelander Paper Co. Location: Rhinelander, Wis.; value: $700,000.

St. Helens Pulp & Paper Co. Location: St. Helens, Ore.; capacity: increase to 35,000 tons; value: $15 million.

St. Regis Paper Co. Location: Pensacola, Fla.; value: $4.5 million.

Scott Paper Co. Location: Everett, Wash.; capacity: 120 tons/day.

Southern Newspaper Publishers' Assn. Location: Southern U. S.; capacity: 50–60,000 tons; value: $12 million.

Southern Paper Mills, Inc. Location: Lufkin, Tex.; capacity: 70,000 tons.

Western Kraft Corp. Location: Albany, Ore.; capacity: 100 tons/day; value: multimillion.

BDSA Containers and Packaging Appointment

Norval W. Postweiler has been appointed deputy director of the Containers and Packaging Div., U. S. Dept. of Commerce Business and Defense Services Administration.

Handling of Containers

The Containers and Packaging Div. of the Business and Defense Services Administration, U. S. Dept. of Commerce, has issued a bulletin (BSB No. 92) titled "Improved Handling of Containers and Packaging Materials Through Simplified

Practice Recommendations." It is pointed out that 75 to 90% of the cost of moving goods from producer to consumer is reflected in the packing, container, storage, and handling costs, the remainder being the cost of transportation. Studies of methods of reducing these costs have resulted in the formulation of Simplified Practice Recommendations for many commodities. These are available at nominal cost from the Government Printing Office, Washington, D. C.

Standard Samples

The National Bureau of Standards, Washington, D. C., has issued Circular 552 (25 cents), listing the various standard samples issued by the bureau. The circular may be obtained from the Government Printing Office, Washington, D. C.

Engineering Graduates

The number of engineers to obtain B.S. degrees this June will be 19,707, according to the Engineers Joint Council and the Scientific Manpower Commission. The largest group is mechanical engineers, of whom there will be 4827.

Toxicity of Spent Sulphite Liquor

Experiments with young wild salmon at the Oregon State College project of the National Council for Stream Improvement have indicated that the concentration of spent sulphite liquor exhibiting threshold toxicity is much higher than that required to deplete the dissolved oxygen of receiving waters. Hence, it appears that should fish mortality occur due to spent sulphite liquor the cause of death would be oxygen depletion rather than toxicity. This finding is in agreement with analyses of the liquor which indicate low concentration of potentially toxic substances in relation to the concentration of oxidizable organic matter.

Sulphite Research League

Stanton W. Mead, president of Consolidated Water Power & Paper Co., Wisconsin Rapids, has been elected president of Sulphite Pulp Manufacturers' Research League, Inc. J. M. Conway, who organized the League in 1939 to conduct cooperative research for 14 Wisconsin and Michigan mills on sulphite pulping by-products and stream improvement, requested that he be permitted to retire from the presidency, which he had held for 15 years. Mr. Conway is president of Charmin Paper Mills, Green Bay, Wis.

Elected chairman of the League technical committee, made up of the research chiefs of the member mills, is John C. Wollwage, director of technical research, Kimberly-Clark Corp., Neenah. Henry A. Rothchild, Kimberly-Clark assistant to vice-president of manufacturing, was elected a trustee replacing Ernst Mahler of Kimberly-Clark, who retired. Mr. Rothchild had previously served as chairman of League technical committee ever since 1939, and in this position has been largely responsible for much of the technical advance achieved by League member mills in utilizing and treating spent sulphite liquor.

Gilbert Heath, mill manager of Falls Paper and Power Co., Oconto Falls, was elected a trustee, replacing Forrest Brainerd who a few weeks previous left this Scott Paper Co. subsidiary to become special assistant to the vice-president of the parent company at Chester, Pa.

Cigars

Cigar sales are soaring and should top 7.5 billion units by 1960. One billion cigars require about 1 million pounds of cellophane, 7.2 pounds of cardboard pulp boxes (rapidly replacing wooden boxes), 12,300 pounds of gum tragacanth, and 81,000 pounds of animal glue for sealing and labeling the package. Moisture-retaining agents such as glycerine and sorbitol are used in substantial poundage.

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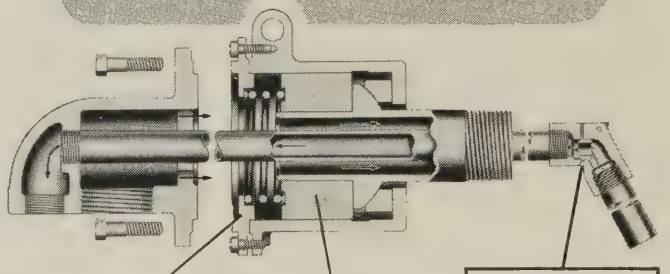

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The following report covers a survey recently completed by the American Paper and Pulp Association, New York, N. Y.

This survey, in addition to showing planned new capacity for future use in papermaking, represents a departure from previous capacity surveys in that an attempt has been made to establish a base capacity for 1953 for the entire industry. In making this study both member and nonmember mills were contacted to determine the over-all rated daily capacity for that year as well as the practical maximum annual capacity, the latter being defined as potential production under ideal manufacturing and marketing conditions. In addition to reports received directly from cooperating mills, which represent about 80% of the total capacity, data were also obtained from the National Paperboard Association and the Bureau of the Census, in such form that the operation of individual mills was in no way revealed. By these means the entire industry was covered, and, subject to errors in reporting on the part of individual mills and plans for expansion developed subsequent to our contact, the data contained in this survey represent a comprehensive and reliable estimate of the industry's current capacity and plans for its expansion through 1960.

It is of interest to note that although the data for the individual grades of paper differ by varying degrees from those previously published, the over-all industry total for capacity as of the end of 1954 is within 1% of that estimated before. The difficulties involved in showing an absolutely correct grade breakdown cannot be minimized, but it is believed that our present estimates are as accurate as possible.

The results of this survey indicate that in 1953, based on 310 days' operation, over-all capacity was 28,199,120 tons. Taking into account the fact that in the case of some mills the normal rate of operation was on the basis of a 7-day rather than a 6-day week, a practical maximum capacity of 29,240,734 tons as reported for 1953 might be more realistic but inasmuch as reported capacity increases for subsequent years are on the basis of 310 days, it would seem better to add such yearly increases to a comparable base.

The planned increase of approximately 500,000 tons reported for 1955 will represent the smallest annual increase since the end of World War II. Of this amount 300,000 tons will be for the production of paper and 200,000 tons for paperboard. Through 1958 more than half of the capacity increase planned is expected to be in paper.

The following table, showing the total capacity increase from 1955 through 1960 by grades, indicates how increases due to new equipment and improvements to existing equipment will affect the industry. The total increase of 1,252,090 tons during this period is a little more than 4% of an estimated over-all industry capacity of 29,190,500 tons as of the end of 1954.

Survey of New Capacity

	1953 annual capacity (tons) — Practical maximum as reported[a]	1953 annual capacity (tons) — 310-day basis
Newsprint	1,147,767	1,075,700
Book and groundwood	3,938,302	3,839,660
Fine	1,357,027	1,355,320
Coarse	3,726,759	3,460,530
Tissue	1,814,808	1,732,280
Special industrial and absorbent	716,429	716,410
Building paper	1,417,021	1,420,110
Total paper	14,118,113	13,600,010
Container board	7,023,970	6,568,710
Bending and nonbending	5,004,398	4,975,296
Cardboard and special stock	1,306,835	1,289,344
Wet board	213,885	229,400
Building board	1,573,533	1,536,360
Total board	15,122,621	14,599,110
Total paper and board	29,240,734	28,199,120

[a] Where annual capacity was not reported, daily capacity was converted to annual on the basis of 310 operating days.

	Capacity increase 1955–1960 (tons)
Newsprint	165,540
Book and groundwood	127,410
Fine	68,820
Coarse	156,240
Tissue	148,800
Special industrial and absorbent	16,120
Building paper	20,150
Total paper	703,080
Container board	266,290
Bending and nonbending	213,590
Cardboard and special stock	11,160
Wet board	6,200
Building board	51,770
Total board	549,010
Total paper and board	1,252,090

The largest increase among the various grades of paper will occur in newsprint as 150,000 tons are added by the close of 1956, to raise the total capacity to 1,422,000 tons. Smaller increases are planned for subsequent years until 1960, when it will become 1,438,000 tons, 33% more than in 1953 and 13% more than in 1954. In the next two years virtually all the increase will result from the addition of new machines, and thereafter by the improvement of existing equipment.

Survey of New Capacity

Estimated capacity at end of year (tons), 310-day basis

	1953	1954	1955	1956	1957	1958	1959	1960
Newsprint	1,075,700	1,272,240	1,350,670	1,421,970	1,432,820	1,437,780	1,437,780	1,437,780
Book and groundwood	3,839,660	3,898,250	3,938,240	3,960,870	3,999,310	4,017,910	4,020,080	4,025,660
Fine	1,355,320	1,428,170	1,479,940	1,491,410	1,491,410	1,496,060	1,496,990	1,496,990
Coarse	3,460,530	3,478,820	3,543,920	3,543,920	3,559,420	3,583,910	3,583,910	3,635,060
Tissue	1,732,280	1,788,390	1,838,300	1,914,560	1,935,020	1,935,640	1,937,190	1,937,190
Special industrial and absorbent	716,410	735,940	752,060	752,060	752,060	752,060	752,060	752,060
Building paper	1,420,110	1,420,110	1,421,660	1,430,960	1,430,960	1,440,260	1,440,260	1,440,260
Total paper	13,600,010	14,021,920	14,324,790	14,515,750	14,601,000	14,663,620	14,668,270	14,725,000
Container board	6,568,710	7,038,360	7,131,360	7,234,900	7,239,550	7,244,200	7,248,850	7,304,650
Bending and nonbending	4,975,296	5,075,426	5,148,896	5,189,506	5,203,766	5,256,156	5,273,206	5,289,016
Cardboard and special stock	1,289,344	1,280,044	1,289,344	1,291,204	1,291,204	1,291,204	1,291,204	1,291,204
Wet board	229,400	236,840	236,840	236,840	243,040	243,040	243,040	243,040
Building board	1,536,360	1,537,910	1,558,680	1,558,680	1,558,680	1,558,680	1,558,680	1,589,680
Total Board	14,599,110	15,168,580	15,365,120	15,511,130	15,536,240	15,593,280	15,614,980	15,717,590
Total paper and board	28,199,120	29,190,500	29,689,910	30,026,880	30,137,240	30,256,900	30,283,250	30,442,590

Survey of New Capacity, 1954–1960
(Tons, annual basis, 310 days)

	1954	1955	1956	1957	1958	1959	1960
			Increases—new machines				
Newsprint	196,540	77,500	62,000	...	...	...	...
Book and groundwood	...	8,060	...	34,100	..	...	...
Fine	46,500	13,330	...	...	...	...	...
Coarse	...	...	...	15,500	24,490	...	...
Tissue	50,530	45,880	75,950	20,150	...	...	...
Special industrial and absorbent	4,650	...	...	...	...	...	...
Building paper	...	...	...	...	...	...	...
Total paper	298,220	144,770	137,950	69,750	24,490	...	...
Container board	364,250	69,750	77,500	...	...	...	...
Bending and nonbending	36,580	86,490	...	...	17,980	...	...
Cardboard and special stock	...	...	...	...	...	...	...
Wet board	5,270	...	...	6,200	...	...	...
Building board	...	...	...	...	...	...	31,000
Total board	406,100	156,240	77,500	6,200	17,980	...	31,000
Total paper and board	704,320	301,010	215,450	75,950	42,470	...	31,000
			Increases—rebuilt machines				
Newsprint	...	930	9,300	10,850	4,960	...	...
Book and groundwood	58,590	31,930	22,630	4,340	18,600	2,170	5,580
Fine	26,350	38,440	11,470	...	4,650	930	...
Coarse	18,290	65,100	...	...	...	...	51,150
Tissue	5,580	4,030	310	310	620	1,550	...
Special industrial and absorbent	14,880	16,120	...	...	...	...	...
Building paper	...	1,550	9,300	...	9,300	...	...
Total paper	123,690	158,100	53,010	15,500	38,130	4,650	56,730
Container board	105,400	23,250	26,040	4,650	4,650	4,650	55,800
Bending and nonbending	63,550	−13,020	40,610	14,260	34,410	17,050	15,810
Cardboard and special stock	−9,300	9,300	1,860	...	...	...	...
Wet board	2,170	...	...	...	...	...	...
Building Board	1,550	20,770	...	...	...	...	...
Total board	163,370	40,300	68,510	18,910	39,060	21,700	71,610
Total paper and board	287,060	198,400	121,520	34,410	77,190	26,350	128,340

Survey of New Capacity, 1954–1960
(Tons, daily)

	1954	1955	1956	1957	1958	1959	1960
			Increases—new machines				
Newsprint	634	250	200	...	...	..	...
Book and groundwood	...	26	...	110	...	..	...
Fine	150	43	...	...	...	..	...
Coarse	...	...	...	50	79	..	...
Tissue	163	148	245	65	...	..	...
Special industrial and absorbent	15	...	...	...	...	..	...
Building paper	...	...	...	...	...	..	...
Total paper	962	467	445	225	79	..	...
Container board	1175	225	250	...	...	..	...
Bending and nonbending	118	279	. .	...	58	..	...
Cardboard and special stock	...	...	...	...	...	..	...
Wet board	17	...	...	20	...	..	...
Building board	...	...	...	...	...	..	100
Total board	1310	504	250	20	58	...	100
Total paper and board	2272	971	695	245	137	..	100
			Increases—rebuilt machines				
Newsprint	...	3	30	35	16	..	...
Book and groundwood	189	103	73	14	60	7	18
Fine	85	124	37	...	15	3	...
Coarse	59	210	...	...	...	..	165
Tissue	18	13	1	1	2	5	...
Special industrial and absorbent	48	52	...	...	...	..	...
Building paper	...	5	30	...	30	..	...
Total paper	399	510	171	50	123	15	183
Container board	340	75	84	15	15	15	180
Bending and nonbending	205	−42	131	46	111	55	51
Cardboard and special stock	−30	30	6	...	...	..	...
Wet board	7	...	...	...	...	..	...
Building board	5	67	...	...	...	..	...
Total board	527	130	221	61	126	70	231
Total paper and board	926	640	392	111	249	85	414

KVP

The efficient handling and shipping of products is the responsibility of many KVP employees—from tree cutting in the woods area, where paper is born, to the loading of a boxcar for final shipment.

The bushworker of KVP's woods department starts the basic raw material on its way to the Espanola pulp and paper mill.

After the wood is cut, new mechanical equipment speeds the hauling-out process. A telescope yarder, by means of a long cable, drags bundles of pulpwood to a central loading area. The pulpwood is then placed on KVP trucks and hauled to rail loading stations where giant cranes load the rail cars.

Upon reaching Espanola the pulpwood is dumped from the rail cars into the mill pond.

An experiment in a new type of wood handling is now underway at Camp 500 at Ramsey, Ontario. Tree length logs, instead of hand cut timber, are skidded by tractor to a central truck loading area. The trees then are hauled to the rail siding where a portable slasher, resembling a troop landing ship, cuts the trees into 8-ft. lengths prior to rail loading.

Once the pulpwood is dumped into the mill pond, it is separated by species, jack pine, and spruce into log booms. From these booms, or rafts, the logs are picked out of the water by a mechanical jackladder and stored or processed.

Wood handling comes to an end when the pulpwood is taken into the mill and manufactured into pulp, ready for use in the two paper machines at Espanola and the six paper machines at Parchment.

Large volumes of raw materials, all necessary to the production of paper, are handled daily by KVP employees. Such items as the following are used by the thousands of pounds each year at Espanola and Parchment: clay, titanium, alum, size, starch, acid, coal, salt, resin, wax, and lime.

Other than pulp or paper, over 1000 tons of chemicals are used each week.

Most of the chemicals which reach KVP plants are conveyed by automatic handling through pipe lines and pumping systems. These systems vary with the products used. Wax, handled in the liquid form, and acid are moved by pumping and air pressure, taken directly from tank railway cars into storage tanks. Solids, such as lime and salt, are handled by mechanical equipment and conveying systems.

Raw materials such as these are controlled by employees of the maintenance or production departments.

Regardless of quality of the product it is useless to the customer unless it is handled, wrapped, and packed efficiently and with care. These responsibilities are entrusted to the materials handling-shipping departments.

From the production departments, KVP papers are moved to the plant warehouses where they are stored temporarily until time for shipment to the customer. Each roll and carton is plainly labeled for quick identification. Moving orders in and out of the warehouses without delay or damage is the job of the shipping employee, whether he is moving thousands of pounds of paper on a "mule" or a smaller load by hand truck.

Skilled personnel are required, too, for the loading of boxcars and trucks. To the average person watching the loaded forklift trucks moving in and out of the conveyances, the operation appears very simple. Such is not the case. The method of loading a boxcar can well determine the condition of the shipment upon arrival at the customer's receiving department.

Before loading can be started it is necessary to clean the car. Floors must be swept and all protruding nails or other objects which might mar the paper removed. To insure absolute cleanliness for KVP's food protection papers, many of the cars are lined with heavy wrapping paper.

Loading the cars is a carefully engineered operation, too. The rolls and cartons are not just stacked in the available space. Proper bracing and binding are essential to allow the cargo to move slightly with each jolt and to prevent packages from falling and being damaged. Shape of the cartons and size of shipment dictate the method of loading required for each order.

In addition to the careful handling and loading, speed is essential in all shipping operations. The shipment must leave the docks on schedule in order to meet the customer's needs. Deadlines also are necessary in order to move empty cars in for loading as soon as loaded trucks and cars pull away from the docks.

After leaving the plants, KVP papers ride the rails and highways crisscrossing North America to customers far and near. When the order is large enough to fill one car or truck, it moves straight from the company's shipping dock to the customer's plant. Stop-offs are made on smaller orders; that is, the nearest customer's shipment is delivered, and the car then moves on to the next customer's plant. In still other cases, shipments are pooled for large cities and there are transferred to trucks for distribution to customers in the area. The routing of orders is handled by KVP's traffic department and is determined by the size of the shipment.

Time is an item at this stage, too. Delays enroute must be avoided if the customer is to receive his paper on the date he specifies for delivery.

Transportation charges also must be considered, since freight rates boost costs to the company and the customer. It is the responsibility of the traffic department to provide the most economical transportation possible and still meet delivery deadlines.

Because of their size and shape, mill rolls require a different method of handling. Clamp-lift tractors and overhead crane hoists are used to move the heavy rolls of paper.

At Espanola, mill rolls are prepared for shipment in the finishing room adjoining the paper machines. From here, after weighing and labeling, tractors carry the rolls down a ramp to the rail cars or transports.

Hamilton, Houston, Devon, and Sturgis use similar unloading methods. Incoming mill rolls from Espanola and Parchment are unloaded by clamp-lift tractors and temporarily stored prior to processing.

Mill rolls, shipped to customers and branch plants, must be as carefully handled as finished products, and the rolls must be efficiently wrapped and loaded for a safe and clean journey to their destination.

WATERMARKING

Papermaking archaeology is very incomplete and in fact one of the most neglected phases of industrial history. Exactly where and when the watermark originated is purely a matter of conjecture. It has been definitely established, however, that paper was watermarked as early as the thirteenth century.

Why was the watermark introduced? Some believe the watermark was originally used as a mark of identification for size of the mold and the paper formed thereon. Some believe their origin can be traced as symbols of the religious propaganda of the Middle-Age heretics. It seems quite likely that religion did play an important part in the development of the watermark. For during the same time the watermark was being developed, Europe was overrun with mystic and puritanical sects among whom papermaking was one of the most highly developed trades.

By 1758 the "Bank of England" was 64 years old and it was in this year that their bank notes were first forged. The rogue who perpetrated this crime was convicted and executed forthwith.

The Bank of England felt that in their watermark they had an infallible criterion. However, in 1778, a certain John Mathieson of Scotland, who was a skilled engraver, began to produce counterfeit bank notes with an imitation watermark

that went undetected for a considerable time. When he was finally apprehended, he agreed to divulge the secret of how he reproduced the watermark only on the condition that his life be spared. The Bank of England felt that it would be a more secure institution if the secret died with John and promptly disposed of both him and his secret.

Between 1797 and 1817, 300 persons were executed for counterfeiting in Britain. Sir William Congreve felt the situation could be licked by further artistic development of the watermark. In collaboration with John Portal, owner of the mill that held the monopoly for bank note paper, he developed a stratified bank note. The note was formed from three different layers of stock. The first layer was formed in the mold with regular white stock. The second layer was formed on top of the first from a colored stock as was the third layer with the exception of white stock being used again. The colored middle layer gave the watermark a brilliance and distinction of color that could not be duplicated by the counterfeiter.

While John Portal helped Sir William Congreve perfect the bank note paper, he fought bitterly and successfully against its adoption by the Bank of England. John envisaged a necessary increase in investment along with other inconveniences.

Notwithstanding, in trying to perform a service for the Bank of England, Sir William Congreve opened an entirely new era of watermarking—the era of light and shade watermarks.

The expense of light and shade watermarks prevents commercial exploitation inasmuch as they can be produced in only handmade papers.

—from *The Barker*, published by the P. H. Glatfelter Co., Spring Grove, Pa.

Paper for Bags

Paper and paper products have become such an important element in the lives of people in the United States that the industry now ranks fifth in size, topped only by automobiles, meat packing, steel, and oil. The use of paper in America is now more than 60% of the world's total use. The per capita consumption in this country has risen to approximately 391 lb., which compares with 250 lb. per person in Canada, 130 lb. in Great Britain, 60 lb. in France, 25 lb. in Italy, 20 lb. in Japan, 10 lb. in Russia, and 1 lb. per person in India.

During the year just passed the paper industry enjoyed its second best in history with an estimated production of 26,300,000 tons, which is less than 1% under the record year of 1953.

Paper industry leaders appear to be quite optimistic for 1955. They predict the volume of paper bags should increase during the year because of the population growth, and particularly due to the increase of self-service methods of merchandising, which require economical as well as fast and efficient packaging.

Undoubtedly, one of the primary reasons for the extremely firm position of the paper and pulp industry today is the sharp increase in exports of paper and wood pulp. New markets have been established and former ones have been re-opened and expanded due to the easing of currency restrictions and trade barriers.

Exports of paper and paperboard from the United States in 1954 totalled approximately 610,000 tons, which was almost 30% above the previous year. Exports of wood pulp from this country increased from 162,000 tons in 1953 to about 400,000 tons in 1954.

Imports from Sweden in 1954 were down about 35%, as compared to 1953, and from Finland, imports in 1954 were 22% lower than the previous year. Imports from Canada increased only about 2% in 1954 over the former year.

Woodpulp prices were increased $5.00 per ton on most grades. The advances on unbleached pulp range from $5.00 to $7.50 per ton with the average qualities now selling at $110. North American and Scandinavian grades of unbleached are now in practically the same price bracket. Scandinavian semibleached and bleached are now $5.00 per ton higher; however, prices remain unchanged on most domestic and Canadian grades.

—from *Bagology*, published by the Chase Bag Co., Chicago, Ill.

Sulphur

The U. S. sulphur industry broke all past production records in 1954 and begins the new year with the greatest productive capacity in its history.

Production of sulphur from all sources in 1954 reached an estimated 6,600,000 long tons, 350,000 tons more than in 1953, according to Langbourne M. Williams, president of Freeport Sulphur Co. Most of this production came from 13 salt dome deposits in Louisiana and Texas mined by the Frasch hot-water process.

The estimate of 6,600,000 long tons of sulphur produced in 1954 is based on preliminary figures. Of the total an estimated 5,450,000 tons is Frasch process sulphur, 350,000 tons in sulphur recovered from gases, 400,000 tons is sulphur contained in pyrites, and 400,000 tons is sulphur in various forms from other sources.

Output of Frasch sulphur was about 300,000 tons more than in the previous year. The gain was made possible by the successful operation of Garden Island Bay, Freeport's new mine at the mouth of the Mississippi. This $14,000,000 mining plant, completed late in 1953, produced in excess of 500,000 tons in 1954.

Output of non-Frasch sulphur increased about 50,000 tons over the previous year. A total of ten projects for recovery of sulphur from sour natural gas and refinery gases and for production of sulphur in various other forms went into production or neared completion in 1954.

As the new year begins, efforts to add further to the sulphur supply are continuing. These include a new Frasch project at Chacahoula dome in Louisiana and eight other projects of various types.

Pulpwood Industry Facts

The importance of the individual landowner in meeting the nation's demand for pulpwood is pointed up in a new booklet, "Pulpwood Industry Facts," just issued by American Forest Products Industries, national sponsor of the American Tree Farm System and the Keep American Green fire prevention campaign. "Most of the pulpwood comes from small ownerships and farm woodlots owned by more than 4,222,000 persons," the booklet points out. "It is probable that the number of people who grow and sell pulpwood in the nation runs into the millions."

Pulp companies, which own or lease only 6% of the nation's commercial forestlands, will always have to buy millions of cords of pulpwood annually from farmers, even after their own lands reach capacity production some 25 years hence. In view of this, the thousand-or-more technically-trained foresters now employed by pulpwood companies are giving increasing attention to providing technical assistance to farmers and small landowners who otherwise might not obtain it.

KVP-Watervliet

The proposed acquistion of Watervliet Paper Co. by Kalamazoo Vegetable Parchment Co. has been abandoned by mutual consent of the boards of directors of the two companies. The action was taken as a result of unfavorable proxies filed by the holders of more than 25% of Watervliet's outstanding stock, although favorable proxies were received from the holders of a majority of such stock. The KVP shareholders filed proxies indicating overwhelming approval of the proposal, only $1/2$ of 1% registering in the negative.

Nepco

The financial plight of Wisconsin educational institutions has been recognized through a new development in the

Nekoosa-Edwards Paper Co.'s Nepco Foundation scholarship awards program for 1955.

This year, in addition to the $500 awards to be granted to each of four qualified applicants, the plan provides for a cost of education supplement equivalent to the tuition but not to exceed $500 a year, to go to the Wisconsin college or university selected by each scholarship winner. The grant will continue during the length of time the scholarship winner is eligible under the awards plan and is in attendance at the school selected. Addition of this feature to the plan has raised the yearly value of the individual scholarship to a maximum of $1000. Inasmuch as awards are renewable yearly for a maximum of three additional years, the value of the individual scholarship may run as high as $2000 for the student and an additional $2000 for the school chosen.

The scholarship awards program of the foundation was put into operation in March, 1953. At present there are eight young people from the central Wisconsin area who are attending various colleges or universities with the help of foundation scholarship awards.

Champion-International

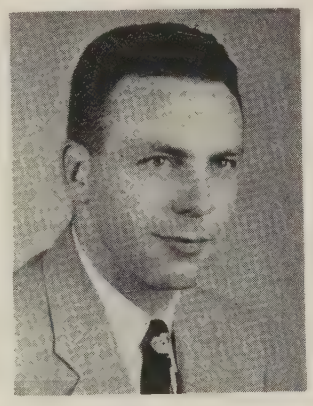
Thomas L. Sterling has been elected vice-president in charge of sales of Champion-International Co., Lawrence, Mass.

Columbia Box

Columbia Box Board Mills, Inc. has opened an office at 1826 Centre St., West Roxbury, Boston, Mass., under Charles H. Goodwin.

Hartford City

T. F. Martin, Jr., has been appointed general superintendent of Hartford City Paper Co., Hartford City, Ind.



T. F. Martin, Jr., Hartford City Paper Co.

Ritchie

W. C. Ritchie & Co., Chicago, Ill., has become a subsidiary of Stone Container Corp., Chicago, Ill., and will continue to operate under its own corporate name.

Rising

H. J. Norton has been appointed director of quality control of Rising Paper Co., Housatonic, Mass. All quality control functions will be grouped under Mr. Norton who will be directly responsible to top management.

W. J. Hassett succeeds Mr. Norton as superintendent and Walter A. Atwood becomes assistant superintendent.

West Virginia

The six integrated mills of the parent West Virginia Pulp and Paper Co. produced the greatest tonnage of paper and paperboard in their history in 1954. To this record 791,500 tons of products made from wood pulp, units operated by our subsidiary, H & D, added another 61,180 tons made from straw, waste paper, and other materials.

While attaining this new level of production the mills were able to improve the quality of nearly every item they produce and, equally important, balance out their raw material needs with the kinds of trees existing in the forests within economic reach of each mill.

The most notable achievement in these two areas was at the Charleston, S. C., mill, which developed Improved Surface Linerboard, known as ISL, used in the manufacture of corrugated boxes. The first product of its kind to be manufactured successfully from a combination of pine and hardwood pulps, ISL not only gives our customers a better product but represents a major step in the company's effort to adapt its pulp-making pattern to the fuller use of more abundant and less costly hardwoods.

Hardwood pulp used in the new linerboard is made in a semichemical pulp mill brought into production at Charleston during the past year. The new facility adds about 100 daily tons of pulp made from gum trees which grow in abundance in the South, but are little used.

Another major contribution to this effort was made by the Mechanicville, N. Y., mill, which succeeded in converting all of its pulping operations to the exclusive use of woods grown locally. Since its construction three years ago, a neutral sulphite semichemical pulping unit at the New York plant has been using only hardwoods. It was not until the past year, however, that Mechanicville was able to convert its second pulping unit, a conventional sulphite operation, to the exclusive use of local woods, including a high percentage of hardwoods.

Although expenditures for improvements during the past year were below the total of any of the five previous years, the company spent more than $9,000,000 in 1954 on facilities designed to improve the efficiency and flexibility of operations and to enable the mills to manufacture products of high quality.

The Charleston, S. C., plant has a daily capacity of 950 tons of kraft linerboard and kraft paper and during the year increased its pulp-making capacity from 1000 to 1100 tons per day. The mill is equipped with two high-speed machines and engineering for a third machine, which may be brought into production late in 1957, was authorized during the year.

The Covington, Va., mill manufacturers food packaging papers and board, kraft envelope paper, and corrugating medium. This mill brought its capacity up to almost 750 tons per day during the year. Covington operates six paper machines and three board machines.

The Luke, Md., mill has a daily capacity of 350 tons of white printing and converting papers made on seven machines. During the year new-type coaters for three machines and an experimental coater were authorized as part of a program to produce higher quality coated grades.

The Mechanicville, N. Y., mill operates six paper machines producing a total of 250 tons of white printing and converting papers per day. New reels and winders to improve the quality of shipping rolls were installed during the year, along with better moisture controls.

The Tyrone and Williamsburg, Pa., plants, which produce 145 and 85 tons of white printing and converting papers per day, laid great stress on quality improvements and the development of papers of lighter weight and greater capacity.

H & D operates board mills at Fort Madison, Iowa, and at Sandusky, Ohio, which have a capacity to produce 120 tons of corrugating board daily. The Fort Madison mill operates one fourdrinier machine and the Sandusky mill operates one small cylinder machine.

Chemical Manufacturing

The company's chemical business is geared to the manufacture of products from components of wood other than the cellulose which is used in paper manufacturing. Over the years the company has developed basic chemical products which have numerous industrial applications.

Active carbon, of which the company is the world's largest producer, is widely used by municipal water supplies and by sugar, food and pharmaceutical industries as a purifying medium. Production of this chemical was expanded considerably during the past year by the installation of additional recovery and refining equipment at the Covington, Va., mill, where manufacturing facilities are concentrated. The

carbon research and development effort was strengthened, too, by the addition of an active carbon pilot plant at Tyrone, Pa., where basic research is carried out, and by additions to the carbon testing laboratory at Covington.

In the field of tall oil, used in the manufacture of paints, varnishes, soaps, and other products, important advances were made. To supplement the output of refined tall oil at Covington, where the company operates the first distillation unit of its kind ever built in this country, plans went forward for the installation of a new unit at Charleston, S. C. The new tall oil refinery is scheduled to be brought into production in the fall of 1955 and will produce about 17,000 tons of refined products annually. In the past the Charleston operation has produced only crude tall oil.

While steps were being taken to expand the production of these two established products, investigation continued on the recovery and utilization of lignin, which forms 25 to 30% of the chemical content of all wood. Lignin products are being produced in a small commercial plant operated at Charleston, S. C., by the newly formed Polychemicals Division. During the year new equipment was added to broaden the applications of lignin in rubber latex compounds.

Future Expansion

West Virginia has a program calling for the investment of $100,000,000 in new plant and equipment over the next five years. Full details of the program have not been worked out, but the board of directors has authorized the engineering and purchase of two new paper machines of advanced design and that a study is being developed to erect an entirely new pulp and paper mill at one of the company's present locations.

The new paper machines and supporting equipment will cost between $20,000,000 and $25,000,000. A machine designed to produce kraft products will be installed in the Charleston, S. C., plant, which is currently manufacturing about 950 daily tons of kraft paper and paperboard on two machines. The other machine, to be installed at the Luke, Md., mill, will be designed to make high quality lightweight printing papers, for which there has been an increasing demand from magazines and other publications. The Luke mill now is producing 350 tons of white printing and converting papers per day on seven machines.

Plans call for the new mill to be located in central Pennsylvania, with the most likely site being Tyrone, where the company presently operates a 145-ton mill producing publication papers. Tyrone is located in a good pulpwood producing area, but the economics of water supply and stream pollution are problems that must be solved before the company can reach a final decision on the site.

Present projections anticipate a mill capable of producing 300 daily tons of hard white papers, some of which would be sold to printing markets and some to the converting field. Broad estimates based on today's costs indicate that a new mill of this capacity will call for an investment somewhere in the neighborhood of $30,000,000.

The company's principal subsidiary, Hinde & Dauch Paper Co., has started construction of a new $2,350,000 box factory at Gastonia, N. C., is ready to begin construction on another box factory at Kansas City, Kans., and has locations for other plants under active consideration.

The company also is developing plans in Canada, where it has a majority stock ownership in Hinde and Dauch of Canada Ltd., which operates with its subsidiaries two paperboard mills and six box factories ranging as far west as Calgary, and in Brazil, where the company has a wholly-owned subsidiary, Rigesa, S. A., which occupies a dominant position in the Brazilian box industry. One project under consideration in Canada is converting the pulp-producing facilities of the H & D mill at Trenton, Ont., from straw to wood. This mill manufactures paperboard which is converted into corrugated boxes by H & D factories.

RAYONIER

In comparison to the conventional southern kraft pulping process, many of the operations required to produce chemical cellulose of the maximum obtainable quality in Rayonier's new Jesup, Ga., mill are highly specialized. Instrumentation has, therefore, been given a great deal of special consideration and engineering thought. In addition to its major role in the control of product quality and uniformity, it also plays an important part in maintaining high production rate.

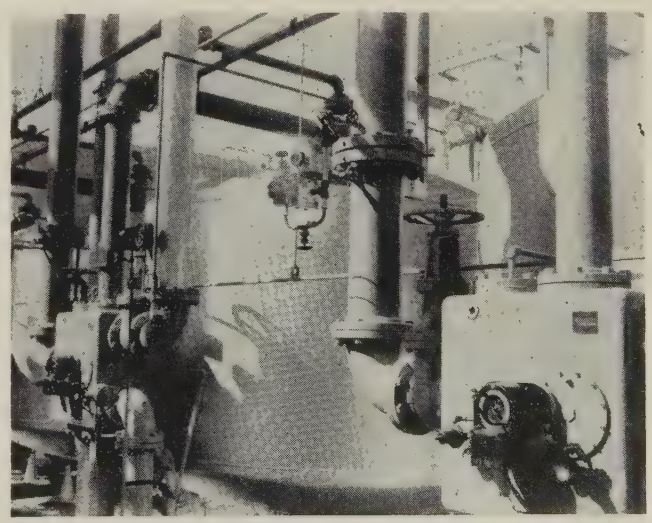
The complete mill process instrumentation was engineered by The Foxboro Co., Rayonier's engineering staff, and Ebasco Services, working cooperatively throughout the engineering stages.

A number of important new instrument applications were developed to provide the most efficient possible processing of this exceptionally high quality chemical cellulose.

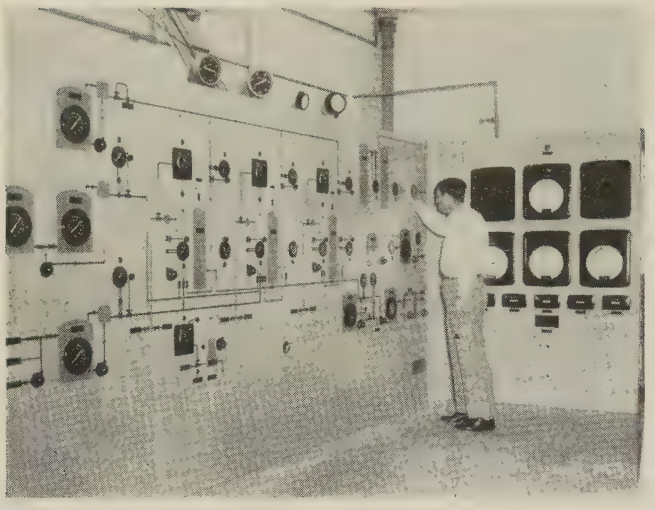
Digester controls are highly specialized in view of the special nature of the process. Although details cannot be disclosed at this time, every variable is precisely measured and controlled. Each digester has its individual control cabinet containing the complete electrical and pneumatic system for the precise execution of the cooking schedules required to produce the desired pulp quality.

The complete system of brown stock washer instrumentation includes an interesting measurement of the chemical content of the weak wash filtrate. This application, developed by Foxboro, provides a more accurate means of setting hot water shower flow in order to strike the most economical balance between chemical loss and evaporator load.

Another interesting instrument highlight is in the blow steam heat recovery section, where the conventional temperature controller for measurement of condenser temperature and control of dirty water to the condenser has been replaced by an alternative arrangement known as the Foxboro "Batch Stabilog Controller." The use of the conventional automatic reset controller on such a batch process has the disadvantage that the controller does not start to control until the pen reaches the control index or set point. In other words, with conventional reset the valve controlling dirty water to the condenser remains closed until the temperature pen rises to the set point, with the result that considerable overshoot occurs and a sizable amount of steam is wasted. The "Batch Stabilog Controller" eliminates this overshoot by lowering the position of the proportional band with respect to the measurement so that control begins before the pen reaches the set point. Actually, the "Batch Stabilog Con-



Typical of modern transmission methods in use throughout the new Jesup mill is this orifice flow metering station in the water treatment plant featuring a Foxboro d/p cell transmitter. Note compact installation with short lead lines to pipe taps

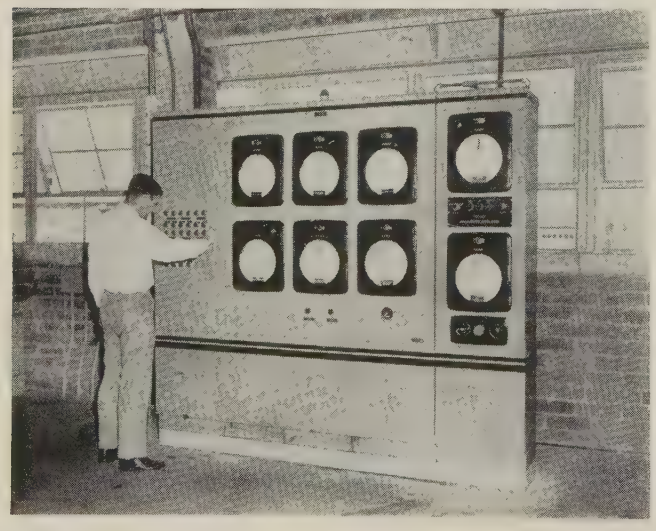


Portrayed graphically on this panel are chlorine dioxide plant equipment with related indicating controllers, simplifying plant operating procedure. Records of important variables are logged by multiple-recording instruments and integrators on wing panel at right, arranged to provide space for addition of future instruments as needed

troller" places the upper limit of the proportional band at the set point until the rising temperature reaches the lower limit of the proportional band after which conventional reset control takes over. "Batch Stabilog Control" has effected substantial steam savings on this application as a result of its ability to control the temperature more accurately.

A graphic panel was selected for the chlorine dioxide plant instrumentation, particularly in view of the fact that the process is relatively new. Thus, graphic representation of the instrumentation in relation to the basic equipment and piping has been utilized to assist the operators in becoming quickly familiar with the process. All pneumatic and electrical controls are conveniently and strategically located on the graphic section of the panel, while recorders and integrators are grouped on an adjacent wing panel. This wing panel includes several Foxboro pneumatic multirecord instruments.

One of the most interesting instruments in the chlorine dioxide plant is the Foxboro d/p cell integral orifice flow transmitter, a new development for use on low flows. This unit is installed directly in the pipeline so that the total flow passes through an orifice built into the cell diaphragm. The differential developed is the same as that measured with a conventional orifice. This unit was installed in the three methanol lines where maximum flows are 0.03, 0.06, and 0.10 g.p.m. It was also supplied for the measurement of other chemical flows of low range in the chlorine dioxide plant.



Wet end controls are cabinet-enclosed, with Foxboro moisture control system at right, Ross Midwest-Fulton drainage controls in center and pushbutton operating stations at left

The chemical preparation area includes several relatively new instrument applications of particular interest. One of these is the automatic caustic dilution control system operating from the measurement of solution conductivity. This Foxboro instrument has automatic temperature compensation and a chart reading directly in per cent caustic strength. The instrument makes it possible to record, and to set the control point, within one tenth of 1% solution strength and provides excellent control.

Because of its highly specilized nature, the bleaching process requires special measurement and control instrumentation. Although details cannot yet be disclosed, all variables are closely measured and controlled with great care. Foxboro furnished a control cabinet at each individual washer for functions concerning strictly local operations, and one standard cabinet assembly centrally located in a glassed-in room for the balance of the records and controls.

Foxboro's new moisture control system has been installed on the pulp drier. This system employs a new type measuring head consisting of a series of small condenser plates. One edge of these plates is flush with the bottom of the hygrometer shoe which is in intimate contact with the upper side of the sheet. The electrostatic field of the condenser passes through the pulp sheet whose dielectric properties vary directly with pulp moisture content. Variations are instantly detected and transmitted to a Dynalog moisture recorder-controller.

Although only the unusual instrument highlights in this new and highly modern Rayonier mill have been touched on here, the great majority of instrument applications and types in those sections of the mill other than the digester room and the bleach plant are already familiar to the industry.

Joseph H. Mache, Jr., has been appointed technical service representative of Rayonier, Inc., New York, N. Y.

Scott

Expenditures for additions and improvements to plants and properties of Scott Paper Co. and its subsidiaries, Hollingsworth & Whitney and Detroit Sulphite, totaled $36,369,756 in 1954. Capital expenditures for 1955 will approximate those of 1954. Part of the funds for continuing expansion were provided through bank loans of $5,000,000 under agreements permitting borrowing up to $40,000,000, and plans for permanent public financing of a portion of the company's expansion program are under consideration.

Scott added 16 papermaking machines during 1954 bringing the total at year end to 42. In addition, technical improvements increased by approximately 10% the output of machines which Scott operated in 1953. Two additional paper machines for the Everett, Wash., mill are under construction. A new machine has been authorized for installation at the Detroit plant in 1955, and another is currently being designed for the Winslow, Maine, plant, with existing facilities at both locations scheduled for modernization this year.

Everett

A third giant, high-speed paper machine went into operation on February 11 at Scott's Everett, Wash., plant.

The huge machine is located in a recently-completed section of the building currently housing numbers one and two paper machines. A quantity of supporting equipment which will convert large parent rolls of paper into consumer-sized units, together with pulp stock preparation units, also have been installed.

Immediately following their work on number three paper machine, construction crews moved across the aisle to begin work on the fourth machine which is scheduled to go into operation later this year. The completion of this machine will bring into realization the company's announcement that four of the most modern papermaking machines in the industry would be constructed at Everett prior to the end of 1955.

The new papermaking facilities are supported by the world's largest bleached sulphite pulp mill which underwent a major expansion program last year to provide additional tonnage of high quality pulp.

Also of major importance in the large-scale building project of the company is the installation of a new boiler to provide the additional capacity required by the paper machines and auxiliary equipment.

There are now over 1200 men and women engaged in the combined pulp and paper making operations at the Everett plant.

Anacortes

A major expansion program at the Anacortes, Wash., mill of the Coos Bay Pulp Corp. will get underway within the near future.

Featured among the installations will be a new wood preparation plant which will be devoted to the processing of cordwood, including alder, for use in the manufacture of bleached sulphite pulp. It will be the first such operation at the Anacortes mill, thus providing an entirely new source of wood for the company. The new plant will be erected adjacent to the existing mill on ground recently purchased by Coos Bay Pulp Corp.

Of special interest in connection with this new process will be the operation of two mechanical barkers especially constructed for the peeling of logs. One of these barkers has been operating at the mill on a trial basis for a number of months. Logs are carried through the barker on trunnion wheels which rotate the log. The bark is removed by side heads with angled teeth. Rotating wire brushes located behind the heads, remove the layers of bark.

Other equipment to be installed in the new debarking plant includes a 112-inch log chipper, conveyors, log hopper, and chip feeders. Auxiliary equipment and construction include a truck unloading ramp, wood storage areas, railroad track spur, and large crane for the handling of wood. Contracts have been signed with the City of Anacortes and the Puget Sound Power and Light Co. for substantially increased quantities of fresh water and electrical power which will be required.

The project will also include facilities for the improved purification of pulp. Stock and caustic soda storage tanks, together with a supporting building, are to be erected.

The Coos Bay Pulp Corp. is a wholly-owned subsidiary of Scott Paper Co. The major portion of the plant's production will be shipped to the new Scott paper mill at Everett, Wash. Here Anacortes pulp will be used in conjunction with pulp produced at Everett in the manufacture of Scott sanitary paper products.

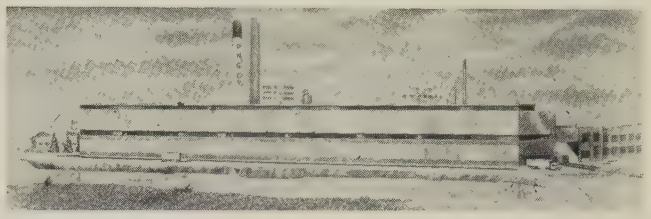
The new facilities which will be operated in conjunction with existing equipment, will result in an increase in the annual production of the mill. It is anticipated that work will be completed by mid-summer of the current year.

GLATFELTER

P. H. Glatfelter Co., Spring Grove, Pa., manufacturers of book, offset, bond, and writing papers, will embark on a new $12,500,000 improvement and expansion program, which will increase the output of the paper mill by 50%.

The program will be financed through the issuance of additional common and preferred stock, by an increase in the funded debt of the company, and from their own resources.

The additional funds will allow the company to add a completely new paper mill to house a new paper machine and finishing facilities in a building to be constructed on the south side of the plant parallel to the Codorus Creek. A new Combustion Engineering Co. boiler for the production of steam and power facilities for the papermaking process will also be installed. A billion gallon water storage to be constructed in Jackson Township, York County, about $1^1/_2$ miles north of the paper mill, is also a part of the current program.



Architect's drawing of the new paper mill to be erected by P. H. Glatfelter Co., Spring Grove, Pa.

The paper machine will be one of the fastest machines of its type in the book and bond paper field. It will produce paper 176 inches wide and will operate at speeds of 500 to 2000 f.p.m. The paper machine will be built by Rice Barton Corp., of Worcester, Mass., and plans call for its operation by the middle of 1956.

BROWN

With modern living and eating quarters, with powerful machines to help him do his job in a more efficient manner, with meals that would impress anyone and with the opportunity to earn an average of $80 per week (some gross as much as $200 per week), the Brown Co. woodcutter is now working and relaxing under better conditions than ever before.

Even though his job is a mighty important one, he is only a small part of the entire woods operation. A great deal of planning is necessary before the task of cutting the wood actually begins.

First, the foresters estimate and cruise chosen stands of timber to determine species and quantity of wood in a given area. This information is given to the men who appraise the various job layouts to determine how the operation should be conducted, what type of equipment will be necessary, where to build woods roads, where to locate camps, and find out about how long the operation will last.

In the Parmachenee area of Brown Co.'s woods operations, nearly 75,000 cords of wood will be produced during this operating season. This includes 30,000 cords of spruce and fir pulpwood, 30,000 cords of hardwood pulpwood, $3^1/_2$ million board feet of hardwood logs, and $2^1/_4$ million board feet of spruce logs.

The section of the Parmachenee area actually being worked includes three complete townships or approximately 120 square miles. All cutting is confined to areas of mature and over mature timber. Areas of second growth timer, or that not yet mature, is left standing for future use.

This immense woods operation, one of the largest in the northeast, consists of four company camps, three contractor operations, and is supplemented by two Brown Co. long log tractor operations which work out of Parmachenee's central headquarters.

The cutting operation at Parmachenee maintains an average working force of 175 cutters and 140 supporting personnel, including swampers, tractor and crane operators, scalers, clerks, foremen, mechanics, blacksmiths, barmen (janitors), cooks, cookees (cook's helpers), and road maintenance crews. About 100 horses and 16 tractors are also needed in this operation.

After the wood has been cut and yarded, the next operation is one of transportation—to move the wood to the mills at

Berlin or to storage areas for later delivery to the mills. This operation requires a fleet of more than 175 trucks working in conjunction with over 35 cranes. Softwood pulpwood is trucked to either of two water landings to await the spring drive down the rivers to Berlin. Hardwood pulpwood is trucked to either of two storage areas during the favorable hauling season when inventories at the mills are high. These huge quantities of hardwood are moved from the storage areas to the mills during the summer season over regular highways when woods roads are too soft and muddy for trucks to travel over. This is an attempt by Brown to put the trucking operations on more of a year-round basis.

Come Spring and plans for the big drive get underway. Nearly 30,000 cords of wood will be moved across Aziscoos Lake, a distance of 14 miles. Booms containing between 2500 and 3000 cords of wood, depending on weather conditions, will be towed by the "Nibroc," a diesel-powered tug boat recently purchased by Brown Company, and then sluiced into the Magalloway River and on into the Androscoggin River—destination, Brown Company's vast operations at Berlin, N. H.

Also entering the Magalloway River from other sources will be about 20,000 cords of spruce, fir, and pine pulpwood and logs.

During the Spring and Summer, river crews will keep the wood moving by pushing, poling, and rolling the wood on to a sorting gap above Berlin where the wood is separated according to species and its final use.

At Berlin, the logs will be removed from the river by "jack-ladder" and conveyed into the storage piles or directly into the barking plant.

The Magalloway District

There are four contractor operations and one company operation in the Magalloway district. These operations produce a total of 45,000 cords of wood, including $3^1/_2$ million board feet of pine.

The Sturtevant Pond operation, part of the Magalloway district, is a unique company and contractor operation. First, the contractor, using his cord cutters and horses, removes the hardwood and spruce and fir pulpwood and logs. This contractor operation is followed by a company operation which removes the mature pine, done mainly by mechanical methods.

The pine logs are trucked directly to the sawmills or to water receiving stations on the Androscoggin River. The pine pulpwood is trucked in long lengths to landings where it is cut into the usual 4-ft. bolts. In all, there are two water landings and one pulpwood storage area.

Androscoggin District

The third Brown Co. woods operating area is called the Androscoggin district where two company operations and two contractor operations produce about 25,000 cords a season.

Thus, our own woods operations produce nearly 150,000 cords of wood in a season for use in the company's manufacturing operations here in Berlin and Gorham, N. H., about 40% of the total amount of wood used annually by Brown Co. The remaining amount of wood consumed by Brown Co. is purchased from concerns and individuals throughout Maine, New Hampshire, and Vermont.

ST. REGIS

Bucksport

In September, a new single-stage peroxide bleaching plant was completed and put into operation at the Bucksport mill of St. Regis Paper Co. This installation enables the mill to bleach its groundwood and sulphite pulps separately and more than doubles the total bleaching capacity. It permits production of brighter papers, and represents the first major step at the Bucksport mill toward a larger output of improved groundwood grades.

Kalamazoo

A high-speed double coater was installed at the Kalamazoo paper mill late in the year. This machine applies the base coat for the top grades of enamel-coated papers, making possible the production of an improved printing surface by the subsequent conventional coating operation.

Pensacola

The expansion in facilities at Pensacola for increased production of bleached kraft papers and boards, referred to in the 1953 annual report, was completed. A five-stage bleach plant of 250 tons daily capacity was built; water supply was increased; screening capacity was enlarged; and no. 1 paper machine was modernized.

Canadian Project

In June, St. Regis Paper Co. and North Canadian Oils, Ltd., of Calgary, Alberta, signed a contract to build a bleached sulphate pulp mill in Alberta, Canada. The pulp mill will have a daily capacity of approximately 400 tons.

This mill will be built by North Western Pulp & Power Co., in which St. Regis has purchased a half interest. The project is estimated to cost $30,000,000. Equity capital of $10,000,000 will be provided equally by St. Regis and North Canadian. Loans are being arranged with the Royal Bank of Canada and the Bank of Nova Scotia. As needed during construction, these institutions will advance up to $22,000,000 to North Western on 5-yr. serial notes. St. Regis will direct the design and construction of the mill and manage its operation. It will purchase part of the output for use in its own mills. The balance will be sold in the open market. Participation in this project will greatly enlarge the activities of St. Regis in Canada.

Using white spruce and lodgepole pine, the mill will have a perpetual pulpwood supply through a long-term timber grant from the Province of Alberta held by North Western Pulp & Power Co., presently covering about 3000 square miles (approximately 2,000,000 acres) of timberland.

Engineering studies and design of the mill are now under way. Construction will begin in mid-1955 and the mill is expected to be completed in 1957.

Carthage

Following the sale of the Harrisville mill in 1953, the Carthage mill took over its manufacture of toweling paper and the conversion to towels. During 1954, this production was expanded at Carthage, and the former production of kraft specialty papers was transferred to the East Pepperell mill. At the year end, the entire paper mill production at Carthage was devoted to toweling, part of which is converted to towels and packaged at the mill. The towels are sold directly to large industrial users.

Measurement of Polyethylene Film

The extruding machines at Carthage and Three Rivers which apply polyethylene coating to kraft paper have recently been equipped with instruments using high-speed electron rays emitted by radioactive thallium to measure the film after it is applied. The instruments are traversed across the paper while it is being coated. This enables the operator to control the weight of the film both lengthwise and across the sheet.

Watertown Mill

In October, St. Regis entered into an agreement for the lease and eventual sale of its kraft paper mill at Watertown, N. Y., to local business interests who are continuing its operation as a paper and board mill.

Franklin

By the end of the year, construction of the new multiwall bag plant at Franklin, Va., had been completed and manufacturing operations had been started. It replaces a plant formerly occupied under a contractual arrangement with Camp Manufacturing Company of Franklin, which supplied most of the kraft paper. The new plant was built to the design of St. Regis engineers, and is occupied under a longterm lease. It will use kraft paper produced at the company's Pensacola and Jacksonville mills.

Semi-Rigid Container

As recorded in the 1953 annual report, St. Regis introduced the semirigid container, a single-wall bag made of 126-lb. specification kraft paper, to replace the carton in which smaller bags are packed for shipment.

During 1954, this new container was adopted by major producers in the flour milling industry. The containers are now being made at both Pensacola and Tacoma. Many baling machines, designed and built by St. Regis for filling this container, have been sold for packaging lines at customers' plants along with auxiliary equipment made by St. Regis. Other industries beside grain milling offer potential markets, a number of which are now being developed.

Fluopacker

In mid-year, St. Regis became national sales and service representative for the Fluopacker filling machine, developed and manufactured by Food Machinery and Chemical Corp. This packer employs an entirely new principle, termed fluidization, for filling multiwall valve bags. It feeds compressed air, at low pressure, into the material at the base of the filling chamber which makes the particles buoyant. The weight of the material creates pressure on the fluidized particles, forcing them down through a filling tube into the bag. The machine provides an additional means of packing powdery and fine granular materials, some of which have been difficult or impossible to pack before. It has been found that some products can be packed in smaller bags for a given weight and less dust escapes in the filling operation.

Embodying improvements worked out with St. Regis engineers, the Fluopacker filling machine has been installed in plants of numerous customers. St. Regis provides users of the Fluopacker filling machine the same field service as on packing machines of its own manufacture.

Bags for Feeds

During the year, sales of multiwall bags to the manufactured feed producers continued to grow. As more companies adopted paper in place of fabric bags, the usage increased at least 25% over 1953. The company has developed filling and closing machines and automatic scales, especially designed for both large and small producers in this industry which is one of the largest markets for multiwall bags still to be fully developed.

Stepped-End Multiwall Bags

The stepped-end bag, which St. Regis introduced several years ago into the United States as a better package for cement, has proved so successful that the company has doubled the capacity at Pensacola for its production. In this type of bag, as the name implies, the individual plies are staggered at each end so that the stepping on the one side is in reverse order from that on the other. When the bottom is formed by folding over and pasting, each ply overlaps itself, forming a construction regarded as the strongest and the most flexible thus far developed for multiwall bags.

Canadian Packaging Operations

Growth in Canada's output of goods and services was interrupted in 1954 by a downturn from the 1953 peak, but at the year end, there were indications of a reversal in trend. Meanwhile progress continued in new construction and the development of basic industries, contributing to further industrialization and growth in the Canadian economy.

International Paper

Mobile, Ala., has been selected as the site of the International Paper Co.'s new $20,000,000 newsprint mill approved recently by the board of directors. The site will be adjacent to that of the present Mobile mill. The decision to locate in Mobile was dictated by many factors. The availability of large timber resources within easy trucking and rail radius of the mill, the presence of an adequate supply of suitable water, the availability of highly skilled labor, and good transportation facilities, as well as the utilization of existing plant facilities and equipment were all important considerations in choosing Mobile as the logical site.

The new mill will have a capacity of 100,000 tons of newsprint per year. It will require 365 cords of pulpwood daily and use approximately 6,000,000 gallons of pure water every day.

The major construction required will be a 1400-ft. building to house the new paper machine and finishing and shipping departments. This building will be located adjacent to the present paper mill buildings, necessitating relocation of present rail lines. In addition to this building plans call for additions to the existing chemical pulp mill and bleach plant, installation of a complete groundwood pulp mill, and expansion of the mill's present wood storage and handling facilities. Extensive additions will have to be made to the mill's existing power plant to supply the power requirements of the new groundwood pulp mill and other new equipment.

A 282-in. newsprint machine incorporating the latest innovations, designed and constructed by Beloit Iron Works in collaboration with International's own engineering and operating staff, will be installed.

International's engineering staff, located at Southern Kraft Division headquarters in Mobile, which has designed and built all of its modern mills in the South, will handle the design and construction of the new newsprint mill. The new mill is expected to be completed and ready for initial operation by August, 1956.

I. P.-A. M. Collins

International has acquired substantially all of the outstanding stock of the A. M. Collins Manufacturing Co., Philadelphia, Pa., manufacturers of specialty coated papers.

The Collins organization, headed by the company's president, Lawrence B. Kelley, will operate as a division of International Paper. The specialty papers produced at the Philadelphia plant will be sold by the present Collins sales staff augmented by members of International's Fine Paper and Bleached Board Division.

Rhinelander-Weyerhaeuser

The Rhinelander Paper Co. and Weyerhaeuser Timber Co. have organized a new firm, the R-W Co., which will immediately start construction of a paper mill at Longview, Wash., for the manufacture of glassine and greaseproof papers. Upon completion of the mill in 1956, the company will offer improved service to customers in the Pacific area.

The company will obtain its supply of wood pulp from the mills of Weyerhaeuser Timber Co.

The officers of the R-W Paper Co. are: Folke Becker, president; W. P. Gullander, vice-president and treasurer; George S. Long, Jr., secretary; and Miss Ruth Neumann, assistant secretary. The directors of the new company are N. F. Becker, B. R. Cancell, and R. F. Nelson of Rhinelander, and J. P. Weyerhaeuser, Jr., Charles H. Ingram, and Howard W. Morgan of Tacoma, Washington.

Mr. Becker, former president of the Rhinelander Paper Co. and now chairman of the board, also is president of Trees for Tomorrow, Inc., the reforestation organization sponsored by Wisconsin paper mills and power companies.

B. R. Cancell is president of the Rhinelander firm.

Bird

Bird & Son, Inc., East Walpole, Mass., has officially opened its new roofing plant at Charleston, N. C.

Bird has established a New Britain Box Division, with headquarters at New Britain, Conn.

Mead

Mead Corp. has installed a new supercalender at its Kingsport, Tenn., mill.

Riegel

Riegel Paper Corp. recently purchased an additional polyethylene extrusion laminator for its Milford, N. J., mill. The machine will be used to poly-coat glassine papers. The new laminator, manufactured by Frank W. Egan and Co., will coat thicknesses of 0.0005 to 0.0015 in. and higher. It includes flying splice unroll and reroll equipment, Egan $4^1/_2$-in. diameter extruder, and a Reliance Electric drive.

Tollie Boyce Cole of Riegelwood, Acme, N. C., has been selected winner of the first Riegel Paper Corp. Scholarship Award. Cole, the son of Mr. and Mrs. Tollie B. Cole, is presently a senior at New Hanover High School, Wilmington, N. C.

Syracuse

Research studies of permeability of resin-treated papers to gases and vapors will be continued at the State University College of Forestry in Syracuse, N. Y., as a result of the renewal of a $7500 grant by TAPPI. A new $4500 grant has been made by TAPPI for basic study of the structure of lignin.

Michael M. Szwarc and Vivian T. Stannett will continue directing the permeability studies with the assistance of John A. Meyer and Charles E. Rogers, graduate fellows at the College of Forestry.

The Association hopes that the project will lead to better understanding of the types of materials to be used for packaging food, instruments, and other items, in order to protect them from the effects of various gases and water vapor. Protection against certain gases and moisture is especially important in storing military supplies which are exposed to unusual conditions of temperature and humidity.

Conrad Schuerch, Jr., who has done research in lignin for the past few years, will be in charge of the new lignin study. He will be aided by Herbert Arlt, a graduate student.

In the preparation of chemical pulps nearly one half of the wood substance has to be removed and most of this material is lignin. Only limited use of this residue can be made at the present time. TAPPI hopes that clarification of the structure of lignin may ultimately lead to its greater utilization.

The Research Corp. has awarded two Frederick Gardner Cottrell grants to the college. One grant for $2000 is a renewal for work on fundamental studies of the structure of lignin. Conrad Schuerch, Jr., assisted by graduate student Kyosti Sarkanen, will make a quantitative study of alcoholysis of lignin. Results of experiments completed thus far will be published soon in the *Journal of Analytical Chemistry*. A new $2500 grant will support a comparative study of the kinetics of homogeneous polymerization initiated by cationic and anionic reagents. Vivian T. Stannett will conduct this fundamental investigation in polymer chemistry.

The college has organized an industry service program to meet the demands of the pulp and paper industry for experimentation and tests on a pilot-plant scale.

The college has for some time maintained a pulp and paper pilot plant for student instruction and research. Because this pilot plant is unique and noncompetitive, the college is now prepared to undertake a limited number of experiments and test operations for industry and various public agencies.

To facilitate this service, the college has organized a Pilot Plant program with a special staff. Frank W. Lorey, Assistant Professor of Pulp and Paper Technology, has been appointed Pilot Plant Group Leader. This program is within the Department of Pulp and Paper Technology under the chairmanship of F. W. O'Neil. Negotiations for experiments or tests are carried out between the company or agency and the College of Forestry. The final agreement is made between the company or agency and the Research Foundation of State University of New York. Costs depend upon the equipment and material used and the services rendered.

The pilot plant of the College of Forestry constitutes a complete semicommercial mill. The facilities include a Great Northern grinder, a 65-cu. ft. stainless steel digester, a Hydrapulper, a Sprout-Waldron refiner, a five-cylinder paper machine, a fourdrinier paper machine (each 54 in. wide), and accessory equipment. There are also laboratories with small-scale digesters, pulp testing and paper testing equipment.

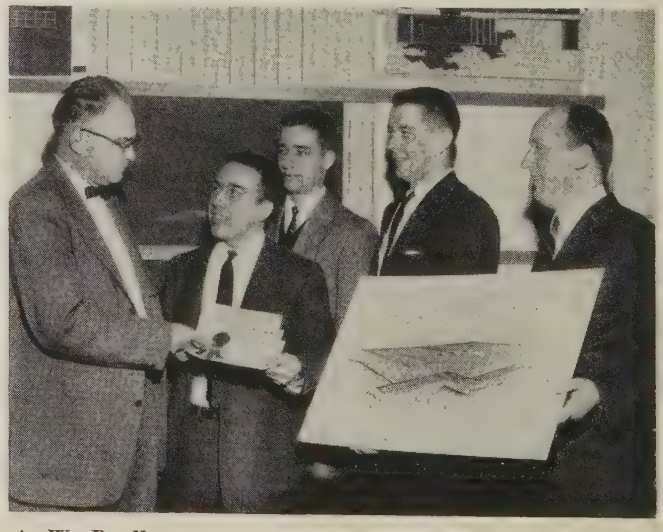
Ipex

The Tenth International Printing Machinery and Allied Trades Exhibition (Ipex) will take place in London, England, July 5–16, 1955.

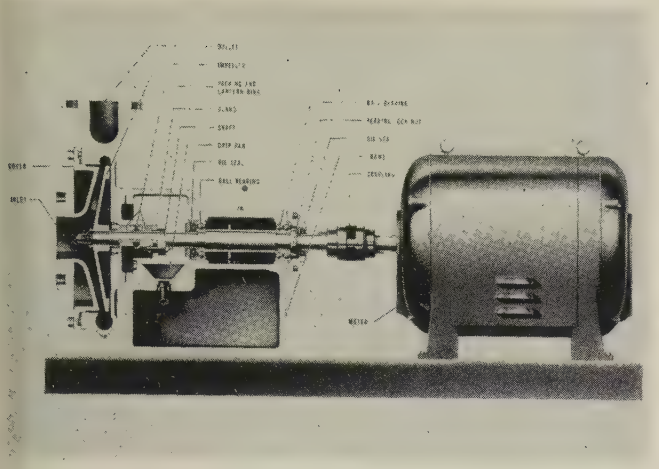
Carnegie Tech.

Rust Architectural Awards were presented for the eighth consecutive year to three students at Carnegie Institute of Technology, Pittsburgh, Pa.

The students, all sub-seniors, received cash prizes from The Rust Engineering Co. for their outstanding designs of a solid-fiber boxboard factory. First prize of $100 for the most original design and excellent presentation went to Theodore Monacelli from Euclid, Ohio. George Brown from Westfield, N. Y., took the $50 second prize, and the third prize of $25 was given to Sandford Pollack from Squirrel Hill in Pittsburgh.



A. W. Brullman, manager of engineering at The Rust Engineering Co., presenting prize checks to winners of the Rust Architectural Awards at Carnegie Institute of Technology, Department of Agriculture. Left to right: Mr. Brullman; Theodore Monacelli, Euclid, Ohio; Sanford Pollack, Pittsburgh, Pa.; George Brown, Westfield, N. Y. Associate Professor John E. Pekruhn (extreme right) who directed the project, holds the prize winning design



The Oliver type L centrifugal pump

Dorr-Oliver

Dorr-Oliver Inc., Stamford, Conn., has added three new sizes to its line of Oliver Type L Centrifugal Pumps, which now includes 1, $1^1/_4$, $1^1/_2$, and 2-in. models.

Western Michigan

Two three-week courses on the principles and practice of coated paper manufacture will be offered between June 20 and July 29 on the Western Michigan College campus. Enrollment for each of the sessions is to be limited to 15 persons. The first session opens June 20 and runs to July 8, while the second begins July 11 and runs to July 29.

Lectures, laboratory work, and mill visitations will make up the concentrated program for the students, with Mr. Nadelman, Robert T. Elias, and Robert N. Zabe of the regular paper technology faculty providing the instruction. Frequent speakers from industry will also be brought on the campus to provide additional information.

All aspects of coating are to be considered, from the raw materials needed, on through the various methods of manufacture and of testing on the finished product.

More detailed information on the program may be obtained by addressing Mr. Nadelman or the office of extension and adult education.

Colby College

The Scott Paper Co. has established a $1000 scholarship at Colby College, Waterville, Me., honoring Michael Lester Madden of Boston. Madden is the former president and chairman of the board of the Hollingsworth & Whitney Pulp & Paper Co. in Waterville which last Fall became a division of Scott.

Achema

Achema XI, chemical engineering exposition and congress, will be held in Frankfurt am Main, Germany, May 14–22, 1955. Copies of the program and other information may be obtained from the Chicago Section American Chemical Society, 86 E. Randolph St., Chicago, Ill.

Design Engineering Show

The Design Engineering Show, previously scheduled for Philadelphia in May, has been postponed until late Spring in 1956.

Johns-Manville

Johns-Manville Corp., New York, N. Y., has published a booklet giving information on "Marinite for Driers, Ovens, Breeching and Housings."

J-M's Relationship Dept. has issued an employee safety booklet, "Let's Play It Safe."

Ingersoll-Rand

Ingersoll-Rand, 11 Broadway, New York, N. Y., has issued an engineering service bulletin, Form 213-A, titled "A Better Air Power System," describing how to go about finding out if more air is being wasted than repair of the air distribution system would cost.

Allis-Chalmers

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has published a bulletin (08B8233) describing its new type KS double-suction Pumps for air conditioning and general purpose applications.

Another A-C bulletin (15B7217B) describes the A-C electronic Metal Detector for inspecting paper, plastics, and many other materials.

Hercules

Hercules Powder Co., Wilmington, Del., has introduced Aquapel, a new product which reacts with the cellulose fibers in paper to form chemical bonds, resulting in a very hard and permanent type of sizing.

Becco

The following new titles have been announced for key personnel of the Becco Chemical Division, Food Machinery and Chemical Corp., Buffalo, N. Y.: F. A. Gilbert, vice-president and assistant division manager; J. F. Shea, vice-president in charge of sales; and W. J. Wetzel, controller.

Condi

L. G. Durant, formerly of Pandia, Inc., has formed a new company, Condi Engineering Corp., to manufacture equipment for continuous pulping. The new company is being financed by E. D. Jones Co., Pittsfield, Mass., and the Alexander Fleck Co., Ottawa, Canada.

Bulkley, Dunton

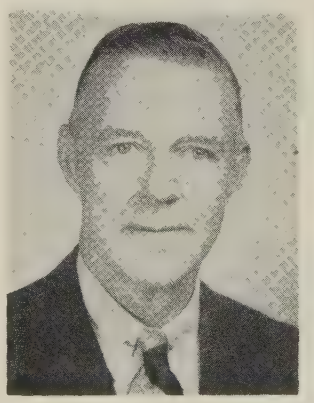
Bulkley, Dunton Processes, Inc., has appointed Rawson & Co., Houston, Tex., R. R. Rothrock, New Orleans, La., and the Henry P. Thomson, Co., Cincinnati, Ohio, as representatives for Bulkley, Dunton equipment.

Patton

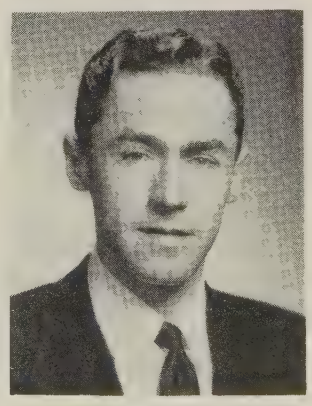
Lowes E. DeWeese has been appointed sales engineer for the newly formed paper mill machinery division of Patton Mfg. Co., Springfield, Ohio.

Waterbury

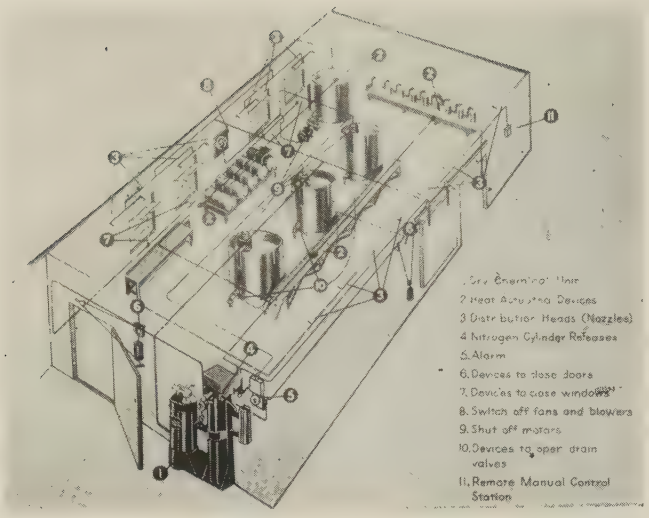
Frederick W. Kopplow has been appointed mid-western representative for H. Waterbury & Sons Co., Oriskany, N. Y.



L. E. DeWeese, Patton Mfg. Co.



F. W. Kopplow, H. Waterbury & Sons Co.


1. Dry Chemical Unit
2. Heat Actuating Devices
3. Distributor Heads (Nozzles)
4. Nitrogen Cylinder Releases
5. Alarm
6. Devices to close doors
7. Devices to close windows
8. Switch off fans and blowers
9. Shut off motors
10. Devices to open drain valves
11. Remote Manual Control Station

Here is how a paint mixing room, in which various flammable liquids are stored, would be protected by the automatic dry chemical piped system developed by Ansul Chemical Co., of Marinette, Wis. This system has been approved by the Underwriters Laboratories after lengthy tests.

In case a fire starts, a heat actuated device automatically reports a fire to the nitrogen cylinder release. Windows and doors are automatically closed, fans and motors are shut off, drain valves are opened and an alarm is sounded. At the same time, dry chemical is expelled through distribution heads in the pipes, and puts out the fire immediately. This piped system can be adapted for installation at many industrial fire hazards

ANSUL

Underwriters Laboratories, Inc., has granted approval to the dry chemical piped system of fire extinguishment developed by the Ansul Chemical Co., Marinette, Wis.

PENNSALT

Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa., has introduced Neoline, a new corrosion-resistant lining compound for fan blades, fume ducts, process vessels, pump impellers, valves, and piping.

HONEYWELL

Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia, Pa. has published a new bulletin (no. 1120) on pneumatic control and transmission systems.

Honeywell bulletin no. 8410 describes Tel-O-Sat, an automatic ratio relay, and Specification Sheet 602 describes internal cam programmer thermometers for maintaining a definite relationship between temperature and time. Bulletin no. 1161 includes a discussion of the basic principles of liquid level measurement.

B & O

The Baltimore & Ohio Railroad is extending its "Tofcee" service for handling highway trailers on flat cars to Washington, Pittsburgh, Chicago, Indianapolis, Cincinnati, St. Louis, Baltimore, and Philadelphia.

CYANAMID

L. C. Duncan has been appointed general manager of American Cyanamid Co.'s Lederle Laboratories Division, and V. E. Atkins is now general manager of the Organic Chemicals Division. Ernest K. Hunt has been named public relations manager of Cyanamid.

Robert T. Schoepflin has been appointed midwest sales representative for the Arizona Chemical Co., jointly owned by Cyanamid and International Paper Co.

Cyanamid paid out $88,649 to its employees under the company's suggestion plan during 1954.

CHEMIPULP

Albert D. Merrill has been re-elected president and treasurer of Chemipulp Process, Inc., Watertown, N. Y. A. E. Thiesen, has been elected vice-president and secretary, and Jack Grant has been elected vice-president.

PHILADELPHIA QUARTZ

LeRoy R. Fischer has been appointed sales manager and T. Marvin Hennessy traffic manager of Philidelphia Quartz Co., Philadelphia, Pa.

SONOCO

Sonoco Products Co., Hartsville, S. C., is planning to establish a branch plant at Longview, Tex.

STEIN, HALL

Stein, Hall & Co., New York, N. Y., through its new, wholly owned subsidiary, Eastern Maine Starch Co., Inc., has purchased the plant and equipment of the Limestone Starch Co., Limestone, Aroostook County, Me.

DOW

Louis E. Tallman has been appointed head of the western section of Dow Chemical Co.'s Plastics Technical Service. E. E. (Mike) Merrill has been named head of the eastern section of the PTS, and Orwin G. Maxson will assist Mr. Tallman in the western section.

DU PONT

"Twenty-five Grasselli Chemicals Aid the Papermaker," is the headline of the February, 1955, issue of *Chemical Briefs*, published by the Grasselli Chemicals Dept. of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

du Pont plans to increase the output of its Edge Moor, Del., titanium dioxide pigments plant.

The company has officially opened a modern, completely equipped sales service laboratory at Chestnut Run, near Wilmington, Del., to develop sound processing and design techniques for plastics.

B & W

The former sales office in Houston of Globe Steel Tubes Co. has been consolidated with The Babcock & Wilcox Tubular Products Division sales office there. A. M. Johnson, who handled Globe sales in the territory has moved into the sales headquarters of B & W's Tubular Products Division at 2134 Welch St., Houston 19. G. H. Weight, southwestern sales manager, is in charge of all Tubular Products Division sales activities in the area.

The former sales office in Cleveland of Globe has been consolidated with B & W's Tubular Products Division sales office in the city. J. J. Lukens, who handled Globe sales in the territory, has moved into the sales headquarters of B & W's Tubular Products Division in the National City Bank Building, 629 Euclid Ave., Cleveland 14. The Cleveland office will be under the general supervision of the division's Beaver Falls district sales manager, James A. Cook.

The former sales office in Detroit of Globe has been consolidated with B & W's Tubular Products Division sales office located in the Ford Bldg., 615 Griswold St. in the city. F. H. Foglesong, district sales manager of B & W's Tubular Products Division will supervise the sales of the division's tubular products as well as welding fittings.

On January 3 the stockholders of Globe Steel Tubes Co., Milwaukee, Wis., approved the purchase of its assets and business by B & W.

B & W's Tubular Products Division has published a folder (TDC 177) giving analyses of standard carbon, alloy, and

stainless tubing steels for elevated temperature and for pressure service.

Ross

J. O. Ross Engineering Corp., 444 Madison Ave., New York, N. Y., has issued a Bulletin (no. 32) on Controlled Conditioning.

American Resinous Chemicals

American Resinous Chemicals Corp., Peabody, Mass., has completed an extensive program of remodeling affecting all the laboratories at the Peabody plant.

International Nickel

International Nickel Co., 67 Wall St., New York, N. Y., has published a bulletin (A-71) giving data on Ni-Resist, corrosion-resistant nickel-alloyed cast iron.

Hooker

Hooker Electrochemical Co., Niagara Falls, N. Y., and Duez Plastics and Chemicals Inc., North Tonawanda, N. Y., have approved a formal agreement for the consolidation of the two companies, subject to the approval of the stockholders of each company.

Herbert Heesch has been appointed general sales supervisor of Hooker.

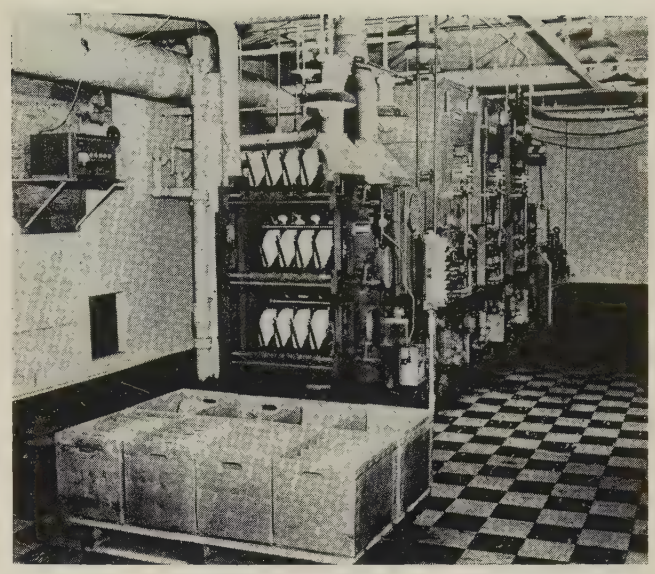
Bolton

John W. Bolton & Sons, Lawrence, Mass., has purchased the name and manufacturing rights of the Hermann Claflin Refiner, from Hermann Mfg. Co., Lancaster, Ohio. Hermann will continue to manufacture and sell TAPPI Standard pulp testing apparatus.

National Starch

National Starch Products, Inc., 270 Madison Ave., New York, N. Y., has approved a $3,500,000 expansion and modernization program involving new equipment at the Plainfield, Chicago, and San Francisco plants, new buildings, and equipment at the Indianapolis plant, doubling the size of the Plainfield research laboratory, and many improvements in equipment.

The Twin Cities Chemical and Allied Trades Association announces the election of officers and members of the Board of Directors for the year 1955. Members of the Board of Directors from left to right include: S. O. Lankaster, Diamond Alkali Co.; A. A. Hibbeler, retiring president, Monsanto Chemical Co.; J. F. Chaney, Hazel Atlas Glass Co.; J. F. Kerns, Columbia Southern Chemical; J. D. Schofield, Barrett Division (not present for picture). Officers: T. A. Wamstad, Mallinckrodt Chemical Co., treasurer; Clifford P. Barth, Merchants Chemical Co., vice-president; William J. Fenelon, Hilex Co., president; Norman P. Anderson, Hawkins Chemical Co., secretary



Champlain press installed at the Gillette Safety Razor Co.

Champlain

Forty-five million razor blade envelopes are printed monthly on a new rotogravure press recently installed at the Gillette Safety Razor Co. in Boston. This high rate of production is accomplished in a normal 40-hour week and at an estimated savings of 35%. The new high-speed press prints, die-cuts and rewinds in one continuous operation. A major portion of the savings is attributed to the design of the envelope and the fact that re-winding eliminates end waste formerly associated with the cutting and stacking of envelopes. In addition to these advantages, the color and appearance of the finished product are more satisfactory than heretofore.

All elements of the "in-line" installation are manufactured by the Champlain Co., Inc., Bloomfield, N. J.

Witco

Witco Chemical Co., New York, N. Y., recently acquired a half interest in Ultra Chemical Works, Paterson, N. J.

Ebasco

W. C. Stratton has been appointed assistant to the engineering manager, and E. L. Seeland has been made superintendent of design for Ebasco Services, Inc., New York, N. Y.

B & W

Babcock & Wilcox, New York, N. Y., have announced plans for a major plant near Lynchburg, Va., for the manufacture of fuel elements and other reactor core components for the nuclear power industry.

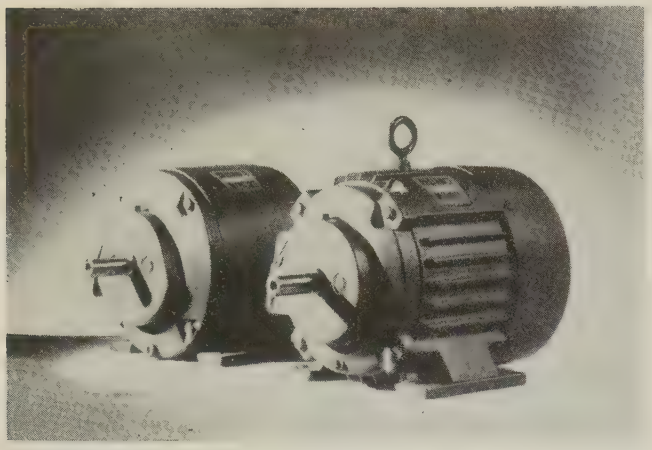
B & W has organized a study of a nuclear power plant system using liquid metal as fuel. The study is being made at the Atomic Energy Commission's Brookhaven National Laboratory by 14 industrial and 3 other organizations.

F. T. Murphy, J. N. Rogers, and C. J. Ponsot have been named to handle the sales of B & W's Tubular Products Division in the St. Louis Area.

Staley

A. E. Staley Mfg. Co., Decatur, Ill., has completed plans for a $200,000 warehouse and sales office building in Chicago. The one-story building will provide 30,000 sq. ft. of floor space and will include tank storage facilities for more than 90,000 gallons of syrup.

Ralph E. C. Fredrickson has been appointed director of the development engineering department of Staley.



Reliance protected a.c. motor (left) and enclosed fan-cooled a.c. motor (right)

RELIANCE

Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, Ohio, has published an information booklet titled "Check the Facts," describing the feature of its new line of totally enclosed a.c. motors.

GRAVER

Graver Water Conditioning Co., 216 W. 14th St., New York, N. Y., has published a Technical Reprint (T-129) which discusses the Treatment of Sewage Plant Effluent for Water Reuse in Process and Boiler Feed.

NATIONAL ANILINE

John K. Boykin has been named resident manager at Charlotte, N. C., for National Aniline Division, Allied Chemical & Dye Corp., succeeding Julian T. Chase, who has retired after 50 years of service. T. M. Ferguson succeeds Mr. Boykin as resident manager at Atlanta, Ga.

DOWELL

Dowell, Inc., Tulsa 1, Okla., has issued a bulletin discussing line cleaning with chemical solvents and pipe line pigs.

D. J. MURRAY

W. A. Marquardt has been appointed assistant manager of the D. J. Murray Mfg. Co., Sausau, Wis.

DIAMOND POWER SPECIALTY

Herman Krapf has been named manager of the Chicago district office of Diamond Power Specialty Corp., Lancaster, Ohio.

C-B

Cleaver-Brooks Co., Milwaukee, Wis., has appointed Ruffridge-Johnson Equipment, Inc., Minneapolis, Minn., as manufacturer's representative for the sale of C-B boiler equipment.

DIAMOND ALKALI

Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, Ohio, has published a brochure titled "A Digest of Diamond Alkali's Dollar-Saving Soda Ash Slurry Storage Systems," describing modern methods of handling and storing soda ash in slurry form.

LODDING

Charles S. Connington, formerly sales manager of Lodding Engineering Corp., Worcester, Mass., has formed his own sales agency and will represent Lodding in New England. John Delany will act as inside salesman and coordinator between the field, the engineering department, and the production department.

FERGUSON

Robert L. Cashen has been appointed vice-president and eastern district manager of H. K. Ferguson Co., Cleveland, Ohio. Mr. Cashen succeeds W. N. Thomson who was recently elected president. Norvon Clark has been appointed assistant eastern district manager.

WALDRON

John Waldron Corp., P. O. Box 791, New Brunswick, N. J., has issued a bulletin (No. 1017) describing the Waldron knife coater.

WIEGAND

Edwin L. Wiegand Co., Pittsburgh, Pa., has established a fellowship at the College of Forestry, Syracuse, N. Y., for the purpose of investigating applications of far-infrared electric heating to the curing of plastic-fiber combinations.

NALCO

National Aluminate Corp., 6216 W. 66th Place, Chicago, Ill., has published a reprint summary (No. 3) giving condensations of four technical articles on the use of sodium aluminate in the paper industry.

GENERAL ANILINE

Leopole Eckler has been elected vice-president of General Aniline & Film Corp. and general manager of the company's Ansco division.

MATERIALS HANDLING

The American Materials Handling Society will hold a conference in Chicago on May 16–18, the first three days of the National Materials Handling Exposition, which will be held in Chicago's International Amphitheatre.

FLAKT

AB Svenska Flakfabriken, Stockholm, Sweden, has incorporated in the U. S. under the name of American SF Products, Inc., 420 Lexington Ave., New York, N. Y. Arne Hallencreutz is president of the new corporation.

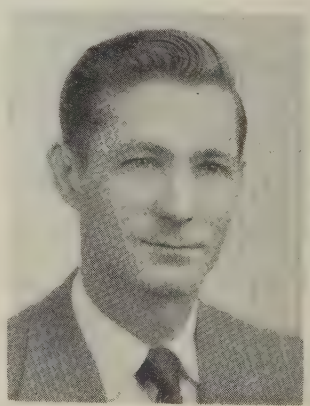
BLACK-CLAWSON

Bruce D. (Don) Hartel has been appointed to assist Black-Clawson Co.'s West Coast sales manager, Gordon Petrie, in the representation of Shartle Division interests in the western area.

William T. Schick has been appointed assistant to the sales manager of B-C's Shartle Division.

Pandia, Inc., division of B-C, has moved its offices to 250 Park Ave., New York, N. Y.

B. D. Hartel, The Black Clawson Co.



W. T. Schick, The Black Clawson Co.

Fiberglas Industrial Building Insulation boards are exceptionally light in weight and are economically installed. Grids are simply formed with tees and purlins and the boards laid in place in the opening

FIBERGLAS

Owens-Corning Fiberglas Corp., Toledo 1, Ohio, is, offering offering a new product, Fiberglas industrial building insulation, which provides thermal and accoustical insulation for roofs and walls as well as being an attractive interior finish.

KINETIC DISPERSION

Kinetic Dispersion Corp., 95 Botsford Place, Buffalo 16, N. Y., has published literature describing its new laboratory dispersion mill, which uses kinetic energy to disperse solid agglomerates in liquid carriers.

PYROXYLIN

Pyroxylin Products, Inc., Chicago, Ill., has introduced a new heat sealing adhesive, Pyroxcote 19-231, for the attachment of vacuum formed blister-type packages.

ANSUL

Ansul Chemical Co., Marinette, Wis., has scheduled 12 three-day classes in industrial firefighting for the Spring and Summer of 1955.

CARPENTER

The Carpenter Steel Co., Alloy Tube Division, Union, N. J., has issued a bulletin giving details on Carpenter 7 Mo stainless tubing and pipe, and one describing two grades of titanium tubing and pipe.

OBITUARIES

Samuel I. Aronovsky

Sâmuel I. Aronovsky, head of the Pulp and Paper Section, Agricultural Residues Division, Bureau of Agriculture, Chemistry and Engineering, Peoria, Ill., died in St. Francis Hospital, Peoria, Ill., on Feb. 27, 1955, after a long illness.

Mr. Aronovsky was born in Kovno, Lithuania, on May 30, 1900, and received his Ph.D. degree from the University of Minnesota in 1929.

From 1922 to 1927 he was chief chemist of the Northwest Paper Co., Cloquet, Minn., and from 1935 to 1937 he was the Northwest Paper Co. resident fellow at The Institute of Paper Chemistry, Appleton, Wis.

He joined the U. S. Department of Agriculture in 1937 as an associate chemist at Ames, Iowa. He transferred to Peoria fourteen years ago.

On May 18, 1955, Mr. Aronovsky received the superior serving award from Secretary of Agriculture, Ezra T. Benson, in Washington, D. C. His citation read "for research leading to new technological developments of national and international significance, for production of paper from agricultural residues, and for initiative and organizational ability which stimulated their industrial acceptance."

Samuel I. Aronovsky

His mechano-chemical process for utilizing straw resulted in high yield with excellent strength and cut down the time required and size of equipment. He was the honor speaker on the manufacture of cellulose from straw at the Eighth International Congress of Agricultural Industries held in Brussels in 1950 and sponsored by the Belgian government.

Mr. Aronovsky published a large number of papers in his field and was chairman of the Fibrous Agricultural Residues Committee of the Technical Association of the Pulp and Paper Industry from its inception until his death.

He is survived by his wife, two sons, four brothers, four sisters, and two grandchildren. Burial was in the West Side Hebrew Cementery in Peoria.

Harry Bennett

Harry Bennett, retired, died at his home in Bronxville, N. Y., on Jan. 20, 1955.

Mr. Bennett was born in New Brunswick, N. J., on May 2, 1883, and graduated as a civil engineer from Princeton University in 1907.

From 1907 to 1911 Mr. Bennett served as a forester and plant engineer for the Laurentide Paper Co., Grand Mere, Que. From 1911 to 1917 he was employed as an engineer by George F. Hardy, New York, N. Y., and was in charge of the construction of the Kenogami, Que., mill of Price Bros. Co. and of part of the construction of the Iroquois Falls, Ont., mill of Abitibi Power & Paper Co. During the 1914 to 1917 period, he was in charge of the expansion of the Cloquet, Minn., and Brainerd, Minn., mills of the Weyerhaeuser Timber Co. He joined the Valley Iron Works as Eastern manager in 1917 and continued in this capacity until 1941 when he retired.

He was a member of the Technical Association of the Pulp and Paper Industry since 1928. He is survived by his widow, a daughter, a son, and a sister. Burial was at Glens Falls, N. Y.

Glenn H. Smathers

Glenn H. Smathers, general superintendent of the Champion Paper & Fibre Co., Pasadena, Tex., died on Feb. 25, 1955, of a heart ailment.

Mr. Smathers was born in Brevard, N. C., on Feb. 17, 1899, and self-educated through the International Correspondence Schools.

He joined the Champion organization at Canton, N. C., in 1917 as a laboratory assistant. He advanced to supervisory positions in the pulping divisions of the company, transferring to the Houston mill in 1935 as a tour foreman.

Mr. Smathers became a member of the Technical Association of the Pulp and Paper Industry in 1941.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Engineering Division

The Engineering Division had a full day of sessions during the Annual Meeting to review activities and complete plans for the next annual Engineering Conference to be held in Houston this Fall.

All committees reported on their program for the Houston meeting. Most of them have their program well set. The committee organizations are in a healthy condition, with some having revamped their groups.

This year we sponsored two special programs on topics of general interest.

We had four excellent papers during an all-morning session, and then a session for half the afternoon under the combined sponsorship of the Chemical Engineering and Corrosion Committees.

J. D. Lyall, chairman of the Engineering Division, announced the formation of the "Sanitary Engineering Committee." G. Griffith, of the West Virginia Pulp & Paper Co., is chairman; and E. Kass, of Gibbs and Hill Co., is secretary.

This committee will deal with engineering methods pertaining to water and waste treatment.

The following are new committee appointments:

S. J. Baisch, Thilmany Pulp & Paper Co., *Chairman*, Corrosion Committee
R. R. Baker, Westinghouse Electric Corp., *Secretary*, Electrical Engineering Committee
R. E. Crossley, Great Northern Paper Co., *Vice-Chairman*, Electrical Engineering Committee
F. D. Helverson, Crown Zellerbach Corp., *Vice-Chairman*, Industrial Engineering and Materials Handling Committee
L. C. Jenness, University of Maine, *Chairman*, Chemical Engineering Committee
J. E. Mailhos, National Container Corp., *Vice-Chairman*, Steam and Power Committee
L. L. Mrachek, The Mead Corp., *Chairman*, Mill Maintenance and Materials Committee
M. J. Osborne, Bowaters Southern Paper Corp., *Chairman*, Electrical Engineering Committee
V. P. Owens, Combustion Engineering, Inc., *Secretary*, Steam and Power Committee

W. C. Bloomquist, *Secretary*

Microbiological Committee

Following are the minutes of the meeting of the TAPPI Microbiological Committee held at the Commodore Hotel, New York, N. Y., Feb. 21, 1955.

The meeting was called to order by Chairman B. F. Shema, W. H. & L. D. Betz. Members present were J. W. Appling, Buckman Laboratories, G. A. Cruickshank, National Aluminate Co., C. G. Humiston, Dow Chemical Co., L. J. Vinson, Lever Bros. Co., R. S. Williams, R. T. Vanderbilt Co., and W. Van Horn, Institute of Paper Chemistry. Also present was R. Drescher, Buckman Laboratories.

Chairman Shema proposed that the position of vice chairman be established. It was also proposed that the chairman, vice chairman, and secretary serve for one year and that only a new secretary be elected each year. This would relieve the chairman of some duties and at the same time initiate the vice chairman into the duties of the chairman.

The above was approved by the committee. C. G. Humiston was elected vice chairman and R. S. Williams was elected secretary for this year to serve with chairman B. F. Shema.

Review of 1954 Activities

Mr. Appling, chairman of the Monograph Subcommittee, reported that the monograph on The Microbiology of Pulp and Paper is complete and ready for editing and publication. The chapters and the authors are as follows:

1. Introduction to Microbiology—G. A. Cruickshank
2. The Microbiology of Pulpwood—B. F. Shema
3. Microbiology of Fresh Water—R. B. Martin
4. Preservation of Pulps—J. R. Sanborn
5. Slimes in Mill Systems and Their Control—J. W. Appling
6. Microbiology of Papermakers' Woolen Felts—B. F. Shema
7. Deterioration of Coatings, Sizes, and Adhesives—C. G. Humiston
8. Preservation of Paper Products—R. Herschler
9. Paper and Paperboard in Food Packaging—R. F. DeLong
10. Microbiology of Spent Sulphite Liquor—A. J. Wiley
11. Miscellaneous Problems—G. A. Cruickshank

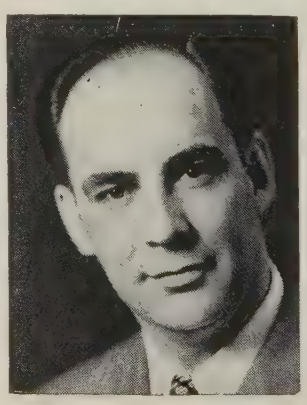
The chairman expressed his feeling that this will be a definite contribution to the monograph series since it represents the first of its kind, and that it undoubtedly will find use as a reference book or even as a supplementary textbook. Special commendation was expressed to Subcommittee Chairman J. W. Appling for organizing this monograph.

It is hoped that this monograph will instill the thought in the industry that the microbiologist has an important function, and that more active participation with the Microbiological Committee will be beneficial to the entire industry.

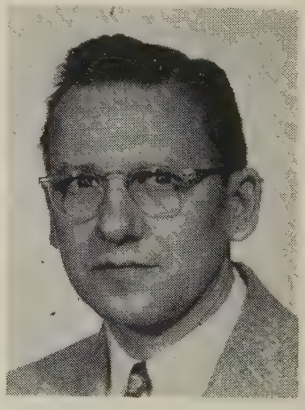
Mr. Appling made a motion that the monograph be submitted to the Division Chairman of Research and Development for final editing and publication with the request that this monograph be cloth-bound because of the potential use as a reference book.

This was approved unanimously by the committee.

Chairman Shema gave a résumé of the data obtained on a possible research project for new methods for the rapid determination of B.O.D. Data from the Battelle Memorial Institute and from the Institute of Paper Chemistry will be submitted to the committee for study and possible instigation of a definite research project on B.O.D.



W. C. Bloomquist, General Electric Co.; General Secretary, Engineering Division



B. F. Shema, W. H. & L. E. Betz; Chairman, Microbiological Committee

It was agreed that the following revisions should be made in the Tentative Standards:

1. Cooling temperature of agar before pouring be changed from 133 to 113°F.
2. Substitution of tryptone glucose extract agar for standard nutrient agar which would increase the number of bacterial colonies.
3. Plate a 1:100 dilution in addition to the 1:10 dilution to encompass conditions where the bacterial count is high.

The committee recommended that the first two revisions be made in Bacteriological Examination of Pulp (T 228 m-52), Bacteriological Examination of Process Water (T 631 m-49), and Bacteriological Examination of Paper and Paperboard (T 449 m-52) and the third revision only in T 449 m-52. It was also recommended that these Tentative Standards be advanced to Official Standards.

It was suggested that the Fungus Resistance of Paper and Paperboard, Tentative Standard T 487 m-54, be discussed with interested parties in the industry to determine their reaction to the test and whether or not any changes could be made in this method to improve it and make it universally acceptable by the industry. This will be undertaken by the vice-chairman and the chairman.

Several possible committee-sponsored projects were discussed. The following suggestions were made:

1. Study of the Microbiological Degradation of the Lignin Molecule—L. J. Vinson
2. Standardization of Methods for the Evaluation of Toxicants for Use in the Paper Industry—J. W. Appling
3. Study of Fundamental Evaluation of Odors as a Direct Result of Microbial Action—G. A. Cruickshank

The chairman and/or the vice chairman will explore the possibilities of joint ventures with other committees wherever possible for the appropriation of funds for these studies. They will also attempt to learn if there would be any overlapping in these studies with any already initiated by the APPA microbiological committee.

In order to expedite these proposed projects the chairman hopes to outline the approaches to these topics as to where they can be done, approximate time necessary, how much they may cost, etc., and circulate it to the committee for suggestions.

It is hoped that a session of papers will be available for presentation at the 1956 meeting. Papers on all phases of pulp and paper microbiology will be acceptable.

The Microbiological Session was held at 9:00 a.m., Feb. 24, 1955, and a very interesting program on papermakers' felts was presented.

R. S. Williams, *Secretary*

Microscopy Committee

The Microscopy Committee met in the Hotel Commodore, New York, N. Y., Feb. 21, 1955, during the TAPPI Annual Meeting.

Eight committee members were present: C. E. Brandon, D. A. Cameron, I. H. Isenberg, H. C. Koch, W. Landes, F. L. Simons, J. W. Wilson, and N. F. Wilson.

Mr. Brandon opened the meeting with a brief statement of regret that conflicting duties made it necessary for him to resign as member and chairman of this committee. The committee expressed its gratitude for his fine work and leadership, and heartily wished him well in the other duties he has assumed.

The committee welcomed Mr. Isenberg as its new chairman.

The first topic on the agenda was the proposed revision of TAPPI Standard T 445 sm-44, Identification of Specks and Spots in Paper. This had been discussed in the committee meeting in Dayton last October. The suggestions brought out in that discussion were incorporated by E. F. Barker into a proposed new method presented for further consideration at this meeting. A detailed discussion of the method as rewritten by Mr. Barker was started, but time did not permit completion of this work at this time. It was left for further study at a later date when such could be arranged.

Mr. Simons reported that arrangements with authors for other chapters of the proposed Monograph on Microscopy previously not yet assigned had been made. He expects that assignments will soon be completed for all the chapters or subjects as presently outlined for the monograph.

Mr. Landes presented for discussion a summary of the nearly 600 replies received to the questionnaire circulated last year on the use of microscopy in pulp and paper mills. It was decided that this valuable information would be assembled for publication in *Tappi*.

The proposed study of fiber weight factors was discussed but an assignment for this work had to be postponed to await further action by the committee.

Time did not permit further discussions, and the meeting was adjourned.

Harold C. Koch, *Secretary*

Water Committee

The Water Committee met in the Grand Ballroom of the Hotel Commodore Monday afternoon, Feb. 21, 1955. A brief meeting was also held, following the Water Session on Tuesday in the South Room, to discuss and confirm appointments and assignments. The following persons were present:

A. S. Erspamer, *Chairman*, Hollingsworth & Whitney Co., Waterville, Me.
A. Thurn, Program *Chairman*, Champion Paper & Fibre Co., Hamilton, Ohio
Seldon K. Adkins, National Aluminate Corp., Chicago, Ill.
Carl L. Anderson, Hammermill Paper Co., Erie, Pa.
Harvey Berg, National Aluminate Corp., Chicago, Ill.
Fred Bishop, Southland Paper Mills, Lufkin, Tex.
R. G. Davis, Scott Paper Co. (Detroit Division), Detroit, Mich.
R. J. Keating, Graver Water Conditioning Co., New York, N. Y.
R. B. Martin, Wallace & Tiernan, Inc., Newark, N. J.
Eskel Nordell, Permutit Co., New York, N. Y.
Edward Poor, Hudson Pulp & Paper Corp., Augusta, Me.
J. J. Priest, Halifax Paper Co., Roanoke Rapids, N. C.
John Samsel, Graver Water Conditioning Co., New York, N. Y.
John S. Shotwell, Consulting Engineer, 380 Riverside Dr., New York, N. Y.
H. J. Skinner, American Conditioning House, Inc., Boston, Mass.
W. A. Tanzola, W. H. and L. D. Betz Co., Philadelphia, Pa.

At the last Annual Meeting of the Water Committee it was decided to rotate the committee chairmanship at 2-year intervals with the program chairman next in line. Accordingly, Mr. Thurn was elected chairman. Mr. Erspamer, the retiring chairman, has consented to remain on the committee and therefore the committee will continue to receive the benefits of his counsel and experience. It is indeed fitting to say that Mr. Erspamer has done an excellent job as chairman and that the committee members are appreciative of his fine leadership.

Carl Anderson was elected to succed Mr. Thurn as program chairman. Mr. Thurn expressed his gratitude to the committee members for the fine cooperation they have given him and asked that the spirit of cooperation continue with the new program chairman.

Seldon Adkins was elected secretary.

It was decided to enlarge the committee membership and to expand geographical distribution of the members. Present members of the committee will suggest or invite persons to membership who, like themselves, are willing to work. It is not necessary to attend the annual Water Session to become a member. To become a member the requirements are that the prospective member be a member of National TAPPI. His application addressed to the committee chairman, should

state his company affiliation, title, and in what particular aspects of the general subject of water he is interested.

Authorized Committee Projects

No. 296. Second Monograph on Water

Mr. Poor, chairman of the Special Projects Subcommittee, reported on the progress of the revision of the Water Monograph. Since the revision requires a great amount of time, he suggested that each chapter be assigned to individual members of the committee for revision. The response was spontaneous for a cooperative effort and a deadline was set for the first draft of all revised chapters to be in the hands of Mr. Poor by September 15. The monograph will be revised with assignments as follows:

Introduction
Chapter 1. A. Thurn
Chapter 2. Vincent F. Waters
Chapter 3. J. S. Shotwell
Chapter 4. R. J. Keating
Chapter 5. R. B. Martin
Chapter 6, Section 1. R. B. Martin
Chapter 6, Section 2. R. B. Martin
Chapter 7. R. B. Martin
Chapter 8. W. A. Tanzola
Chapter 9. Eskel Nordell
Chapter 10. Berg and Adkins
Chapter 11. W. A. Tanzola

No. 466. Research Project No. 466

Suspended Solids Determination by Buchner versus Gooch Methods:

A good correlation has been found with these two methods on two types of water wastes. A formal request will be made to TAPPI for a research grant of $1500 to continue the project with the investigation of additional types of wastes.

No. 208. Preparation of Routine Control Methods

Mr. Anderson reported that Special Report 399, "Analytical Methods Survey of Pulp and Paper Mill White Waters and Effluents," indicates a wide variety of analytical methods. The possible application of a questionnaire was discussed whereby standard methods of analysis could be evolved. This could develop into another research project. Since Mr. Anderson is the new program chairman, it was decided to ask the committee chairman to request some other member of the committee to follow this investigation.

Miscellaneous

A joint project with the Conservation Foundation relative to water use requirements in the pulp and paper industry was discussed. Mr. Erspamer will remain in contact with the Conservation Foundation on this matter.

A letter from Battelle Memorial Institute was read relative to facilities available for research projects. The committee appreciated the knowledge of an additional source of research facilities on water problems.

The preparation of data sheets pertaining to various phases of water were discussed. It was agreed that such data could be of great value. Due to the press of time no disposition was made concerning development of this subject into an active project. However, it was suggested that an outline be made of a project whereby the preparation and formulation of data sheets could be realized.

ARTHUR THURN, *Chairman*

Paper Testing Committee

A meeting of the Paper Testing Committee was held at the Commodore Hotel, New York, N. Y., on Feb. 21, 1955.

D. H. Newcomb, chairman, and 16 members were present. Since Mr. Newcomb has served four years as chairman, an election of officers was held with the following results:

Chairman: L. Price, Government Printing Office, Washington, D. C.
Vice-Chairman: R. J. Becker, Riegel Paper Co., Milford, N. J.
Secretary: W. P. Dohne, Dixie Cup Co., Easton, Pa.

The committee reached an agreement that the officers would serve a period of 2 to 3 years.

Various test methods under study were reported as follows:

1. *T 437—Dirt in Paper:* R. H. Wiles, J. T. Ward.
   Revisions are complete, and this standard is ready to submit for approval.
2. *T 455—Wire and Felt Sides of Paper:*
   Revisions are complete, and this standard is ready to submit for approval.
3. *T 454—Turpentine Test for Grease Resistance of Paper:* S. C. Fairbanks, W. P. Dohne.
   Considerably more study is required on this procedure, including the following:
   (a) Method of reporting (glassine and greaseproof group feel two-thirds of tests should be above trade limits).
   (b) A standard method of creasing should be incorporated.
   (c) Reporting of pinholes clarified (T-485).
   (d) Since this method is intended for uncoated, unimpregnated greaseproof, glassine, and vegetable parchment, a separate method or an additional section to the present method is necessary to include barrier materials (laminated-coated).
4. *Thickness of Various Papers:*
   (a) Thickness of thin paper—P. F. Wehmer.
   (b) Thickness and bulk of tissue—J. T. Ward.
   (c) Thickness and bulk of book paper—B. L. Wehmhoff.
   Mr. Wehmer reported that Testing Machines, Inc., has recently come out with a motor-driven caliper which he feels is good and should be given consideration.
   R. B. Hobbs, reporting for Mr. Wehmhoff, brought up for discussion the matter of sampling, bulking 1 in. of paper in 3 in.-squares or at a given distance from the edge of full sized sheets. Necessary accuracy was discussed. B. Q. Haynes, of B. F. Perkins, stated that, in redesigning a new instrument, it is necessary to know these various test conditions.
   An additional study is required on all three methods.
5. *T 433—Water Resistance of Paper and Paperboard—* R. B. Hobbs.
   The Ames Chemical Co. would like to submit three different dry indicators for evaluation in this method. ASTM revised their method approximately two years ago. The Thwing-Albert Instrument Co. also market and sell dry indicators for this test. Mr. Becker (Riegel) and Mr. Price (G.P.O.) agreed to compare the present TAPPI method, the ASTM method, the three Ames and one Thwing-Albert dry indicators.
6. *T 478—Ink-Erasing Quality of Papers:* P. W. Codwise.
   Mr. Codwise was not present; however, information received indicated that he is continuing study of this project.

At the suggestion of Ralph Green, the entire committee expressed sincere appreciation to Mr. Newcomb for his fine work and leadership as chairman of this committee.

W. P. DOHNE, *Secretary*

Patents Committee

A Patents Session was held in the West Ballroom of the Commodore Hotel on Wednesday, Feb. 23, 1955, at 3:30 p.m.

F. W. O'Neil, College of Forestry, State University of New York; Chairman, Mechanical Pulping Committee

H. F. Lewis, The Institute of Paper Chemistry; Chairman, Fundamental Research Committee

At the end of the first paper on "Patent Office Practice," by F. Makara, New York, N. Y., many questions were asked so that the speaker ran over his alloted 30 min. Similarly many questions were asked concerning the paper on "Recent Court Decisions," by Mr. Makara.

One of the questions raised by the audience was that of co-inventors being co-owners of undivided interests. Also, its corollary that owners of undivided proportionate shares of an invention disclosed and claimed in a patent are owners jointly and severally. In other words, owners of undivided interests of a patent do not have to account to each other co-owner for any money received by them for the sale or licensing of their co-ownership interest. This is contrary to the common conception that an owner of, for example, 5% of a patent is entitled to only 5% of the profits of the patent. As stated above this is not so. The co-owner of any percentage, even less than 1%, can sell or lease his interest in the patent without any accounting whatsoever to his co-owner for the money he received.

Another question raised by the audience was that of the number of examples of chemicals necessary to obtain broad coverage of a generic chemical class.

Still another question was the legality of a broad claim in a patent that covered species that in part were inoperative.

The third paper was given by Mr. Robertson of Hudson Paper Bag Co., Palatka, Fla., in lieu of T. Collins, also of Hudson Paper Bag Co. The talk on the use of micro-cards was most interesting. After the talk, Harry Lewis, Institute of Paper Chemistry, Appleton, Wis., spoke about his interest and experience with micro-cards. A micro-card demonstration was set up outside the Ballroom door and was a source of much interest.

N. Bauer, a registered patent attorney of Union Bag and Paper Co., has joined the Patents Committee and his interest in these matters is most welcome.

F. Makara, *Chairman*

Mechanical Pulping Committee

A meeting of the Mechanical Pulping Committee was held at the Commodore Hotel, New York, N. Y., Feb. 22, 1955. Those present were: F. W. O'Neil, E. H. Johnson, J. K. Kirkpatrick, T. F. La Haise, R. S. Magruder, W. H. de Montmorency, John D. Moore, N. F. Robertson, A. J. Winchester, J. H. White, K. L. Pingrey, and J. H. Perry.

F. W. O'Neil consented to serve as chairman for another year. J. H. White was elected to the new office of vice chairman, and J. H. Perry was re-elected to the post of secretary. The regional committees or subcommittees retain the same personnel as decided Feb. 16, 1954, namely: Program and Publications Subcommittee—T. F. La Haise, chairman, with W. H. de Montmorency, and Karl Pingrey serving with Mr. La Haise. West Coast Subcommittee—N. F. Robertson, chairman. He will select his committee from the groundwood operators on the West Coast

The committee regretfully accepted the written resignation of T. E. Kloss, who felt that, since he was unable to attend meetings, someone else should be appointed who could be of more value to the committee. John D. Moore of the Oswego Falls Corp. was selected to serve in place of Mr. Kloss. Membership of the committee is now as follows:

F. W. O'Neil, *Chairman*, State University of New York, College of Forestry, Syracuse 10, N. Y.
J. H. White, *Vice-Chairman*, Keyes Fibre Co., Waterville, Me.
J. H. Perry, *Secretary*, Norton Co., Worcester 6, Mass.
E. H. Johnson, Stevens and Thompson Paper Co., Greenwich, N. Y.
J. K. Kirkpatrick, Bowaters Southern Paper Corp., Calhoun, Tenn.
T. F. La Haise, Imperial Paper and Color Corp., Plattsburg, N. Y.
J. H. Heuer, Great Northern Paper Co., Millinocket, Me.
R. S. Magruder, Sprout Waldron Co., Inc., 729 Dayton Ave., Kalamazoo 18, Mich.
W. H. de Montmorency, The Pulp and Paper Research Institute of Canada, 3420 University St., Montreal, Que., Canada
N. F. Robertson, West Tacoma Newsprint Co., P.O. Box 8, Steilacoom, Wash.
K. L. Pingrey, The Diamond Match Co., Ogdensburg, N. Y.
John D. Moore, Oswego Falls Corp., Fulton, N. Y.

The Special Report No. 400 on groundwood bleaching was completed and published during the year, as was No. 402 on "News and Hanging." The "Tissue & Toweling" section is about complete, lacking only the "Thickening" section, which is the obligation of J. H. Perry. The "Book Pulp," thickening and screening section will be forthcoming from J. K. Kirkpatrick within a month and A. J. Winchester reports that the "Board and Insulating" report will soon be published.

T. F. La Haise, general chairman, reported that plans for the "Second International Mechanical Pulping Conference" at Poland Spring, Me., were progressing very well. The program co-chairmen, W. H. de Montmorency and J. H. White, have completed a comprehensive and well-rounded technical program and satisfactory progress has been made in the various other phases of the joint conference.

The feasibility of a groundwood book was again discussed and it was the consensus of the committee that such a book could be of great value to the industry. However, it was decided that all members should critically review all published material on groundwood operations especially the groundwood section, "Pulp and Paper Manufacture," Volume I. If the published material does not contain sufficient detailed fundamental information then the committee should give consideration to supplementing the groundwood section of Pulp and Paper Manufacture or to the publication of an adequate book. With this thought in mind, the members were assigned sections of the suggested outline for mechanical pulping handbook, minutes of committee meeting May 20, 1954. Each member is to prepare a bibliography presented in the form shown on pages 43 to 51 in the 1954–55 year book. It was suggested that the bibliography should include the patent section as well. Each member to make 25 copies of his section to be circulated to all members of the committee. The assignments are listed below:

1. Brief History and Description of the Groundwood Process. R. S. Magruder.
2. Properties of Groundwood and Its Uses. W. H. de Montmorency.
3. Woods and Their Effect on Groundwood Pulp Properties. Karl Pingrey.
4. General Description of a Groundwood Mill. E. H. Johnson.
   General Description of Types of Grinders, Screens, Thickeners.
   Operating Personnel of the Groundwood Mill.

5. Present Practices and Trends in Groundwood Manufacturing. J. H. Perry.
6. Bleaching. Neil Robertson.
7. Wood Pretreatment. Fred O'Neil.
8. Techniques for the Control of Operating Variables. J. K. Kirkpatrick.

The secretary is to review the scope of this committee in the yearbook and report at the next meeting.

F. W. O'Neil tentatively set April 21 as the date for the next committee meeting and New York City as the location most convenient to all.

J. H. Perry, *Secretary*

Fundamental Research Committee

The regular February meeting of the Fundamental Research Committee was held in Room A of The Chemists' Club, New York, N. Y., on Saturday, Feb 19, 1955. Present were G. A. Day, Brown Co.; G. K. Dickerman, Consolidated Water Power and Paper Co.; R. M. Dorland, Abitibi Power & Paper Co., Ltd.; Gerald Haywood, West Virginia Pulp and Paper Co.; W. M. Hearon, Crown Zellerbach Corp.; J. R. Salvesen, Marathon Corp.; J. C. Wollwage, Kimberly-Clark Corp.; and H. F. Lewis, The Institute of Paper Chemistry.

In line with the agenda set up for the meeting, the following actions were taken:

1. In the matter of committee structure it was decided to retain for the 1955 year the same structure as the committee has had in earlier years, with H. F. Lewis as chairman and the following as members:

G. A. Day, Brown Co., Berlin, N. H.
G. K. Dickerman, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.
R. M. Dorland, Abitibi Power & Paper Co., Ltd., Toronto, Canada
Gerald Haywood, West Virginia Pulp and Paper Co., Luke, Md.
W. M. Hearon, Crown Zellerbach Corp., Camas, Wash.
J. R. Salvesen, Marathon Corp., Rothschild, Wis.
D. T. Jackson, Hammermill Paper Co., Erie, Pa.
R. N. Griesheimer, The Mead Corp., Chillicothe, Ohio
J. C. Wollwage, Kimberly-Clark Corp., Neenah, Wis.
H. F. Lewis, The Institute of Paper Chemistry, Appleton, Wis.

2. The scope and objectives of the work of the committee were discussed for some period of time, and it was decided that since the scope as described in the 1954–55 Yearbook had been prepared in 1932, it should be brought up to date.

The following tentative wording was adopted, and members of the committee are urged to review this wording and immediately either approve or submit modifications.

"The functions of the Fundamental Research Committee shall be as follows: to foster and stimulate fundamental research in the scientific fields related to the pulp and paper industry by (a) establishing projects and obtaining funds for colleges, universities, and research institutions to support those projects in line with the procedures of the TAPPI Executive Committee and Research Appropriations Committee. Such projects shall be in the field of fundamental scientific work. (b) Assisting in the dissemination of fundamental research information through the sponsorship of symposia on specific subjects and by other programs and reports at the various meetings of the Association and the preparation of suitable monographs and other appropriate publications. (c) Aiding in the planning and administration of research in the industry by stimulating discussions and organizing meetings and papers along these lines."

The Fundamental Research Committee believes that a very important by-product of (a) will be the stimulation of greater interest in our industry as a field of employment on the part of students in these various institutions where the projects are established as the staff members become better acquainted with its problems and opportunities.

3. Plans for the 1956 Annual Meeting. It was decided that no subject would be more timely for next February than that dealing with "The Availability of Scientific and Technical Manpower." The committee voted unanimously to set up a symposium on this subject for at least a half a day's session in February, 1956. This would be in addition to any general session covering papers dealing with current fundamental research.

4. Plans for a 1955 Fall Meeting. J. R. Salvesen was appointed at an earlier meeting of the committee to report on the interest in a meeting on the theoretical aspects of bleaching. During the past months he has been in communication with a number of Canadian and European scientists who may have been working in the field and finds that there is a very enthusiastic interest expressed. Consequently the committee decided to schedule for a Fall Meeting in Appleton a symposium on "The Theoretical Aspects of the Chemistry of Bleaching," or possibly a better subject would be "The Fundamentals of Bleaching," and has set as the dates (subject to change) September 15, 16, and 17. This is the last half of the week of the A.C.S. meeting in Minneapolis where there will be programs of interest to the Europeans and is sufficiently far in advance of Mr. Jayme's probable commitments on the West Coast. We propose to use Mr. Jayme in one way or another in the bleaching symposium. Mr. Salvesen has agreed to be chairman of the meeting. A rough plan of organization of the meeting includes a long session to be devoted exclusively to summing up and listing of the areas needing research. Tentatively we are talking of papers on Thursday and Friday and discussion on Saturday.

5. Subcommittee Reports on Project Fields. (A) Subcommittee on Beater Additives. A grant was requested of TAPPI to complete the Jackson, et al., bibliography on beater additives. (B) Subcommittee on the Sulphur Chemistry of the Kraft Process. Two projects were set up at Reed College and Vanderbilt University.

6. Committee Projects 1954–55 and Projects for 1955–56.

Project 53. Evaluation of Surface by Dye Adsorption, University of Maine. Mr. Thode was on the program of the 1955 February TAPPI meeting with the last two reports on his project. One of these appeared in *Tappi* this month (February) and the other will be submitted for publication later. The project is closed.

Project 54. Study of the Carbonyl Groups in Lignin, Bucknell University. A progress report has been submitted by Mr. Smith on the status of this project. He has money enough left from the original grant to cover one summer's work with students, and then the project will be closed.

Project 55. Sulphonation of Lignin with Sodium Sulphite, The Institute of Paper Chemistry. The final report of this project has been written up but is waiting for Mr. Brauns's return from Austria before it is submitted to the committee. A continuation is not being requested.

Project 56. Fundamentals of Neutral Sulphite Pulping, D. J. MacLaurin, The Institute of Paper Chemistry. Two progress reports were given at the TAPPI meeting in New York and will be submitted for publication in *Tappi.* An extension has been requested for this project, but action was not taken at the present time. In view of the interest in the papers presented by Mr. Stone, we should give immediate consideration to the extension requested by MacLaurin.

Project 60. Action of Water on Cellulose at 100 to 225°, University of Toronto. The final report on this work was presented by Mr. Rapson at the current TAPPI meeting and will be submitted for early publication in *Tappi.* The report was presented in full by Mr. Rapson at the meeting.

Project 62. Composition of Pulpwood Barks, Forest Products Laboratory. The final report on this project has been submitted by Chang and Mitchell; it was presented at the February, 1955, TAPPI meeting by Mr. Saeman. No extension is being requested.

Project 65. Hemicelluloses in Spruce, Loblolly Pine, and

Douglas-Fir, Queen's University, Kingston, Ont., Canada. A progress report on this project has been submitted by Mr. Jones and a request for an extension of the work has been submitted.

Project 68. Lignin Dimers, Mr. Schuerch, State University of New York. Progress reports of this project have been submitted and were picked up by all members of the committee at the meeting. Obviously very little could be reported at this very early date.

In addition, we had submitted six other requests for projects, including one at Boston University on "The Action of Aqueous Chlorine in Carbohydrates"—Project 75. An extension of Mr. Jones's project at Queen's University, "Examination of the Uronic Acid Components of Pulpwood." "Preparation and Chemical Properties of Polymer Homologous Oligosaccharides," Mr. Wolfrom at Ohio State University—Project 77. "Behavior of Nucleophilic Reagents with Lignin Molecules," Mr. Cronyn at Reed College—Project 78. "Sulphur Chemistry of the Kraft Process," Mr. Field at Vanderbilt University—Project 79. And "Review Literature on Beater and Wet End Additives," Institute of Paper Chemistry, John Swanson—Project 80. Project 80 received clearance from the committee and was brought up for discussion at the Executive Committee meeting by Mr. Macdonald, since he thought it represented a departure from the previously considered research program.

The symposium on Fundamental Research Committee projects on February 22 was attended by an average of 100 people. Mr. Parsons' report was listened to with interest, and the papers given by the various speakers (including Mr. Thode from Maine, Mr. Stone from the Institute, Mr. Rapson from the University of Toronto, and Mr. Saeman who presented Mr. Chang's paper) were well presented and had good attention.

The reprints of the Paper Machine Symposium have now been prepared, and a copy is being sent to every member of this committee from those purchased by the Institute. I think a good job has been done.

The meeting of the Fundamental Research Committee was a very good meeting in every way. Discussions were active and to the point. The chairman of the committee extends his appreciation to all the members of the committee for their continued interest in fundamental research and for all the work they have done on the committee during the past year.

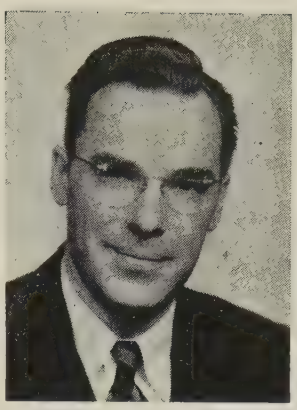
HARRY F. LEWIS, *Chairman*

Statistics Committee

The TAPPI Statistics Committee held a meeting at the Hotel Commodore, New York, N. Y., at 9:30 a.m., Monday, Feb. 21, 1955.

The persons present were:

Geoffrey Beall, University of Connecticut, Storrs, Conn.
C. A. Bicking, Department of the Army, Washington, D. C.
M. W. Block, Stone Container Corp., Chicago, Ill.
R. R. Chase, Union Bag & Paper Corp., Box 570, Savannah, Ga.
A. H. Croup, Hammermill Paper Co., Erie, Pa.
T. H. Geiger, Oxford Paper Co., Rumford, Me.
H. W. Gerhart, Scott Paper Co., Chester, Pa.
Wm. D. Hall, Folding Paper Box Assoc. of America, Chicago, Ill.
Charles M. Koon, Oxford Paper Co., Rumford, Me.
John F. Langmaid, Jr., S. D. Warren Co., Cumberland Mills, Me.
Ked Martin, Fortway Corrugated Paper Co., Hartford City, Ind.
W. E. Moore, Forest Products Laboratory, Madison, Wis.
T. A. Pascoe, Nekoosa-Edwards Paper Co., Port Edwards, Wis.
F. E. Pendleton, Jr., Fitchburg Paper Co., Fitchburg, Mass.
M. S. Renner, Dewey and Almy Chemical Co., Division of W. R. Grace & Co., Cambridge, Mass.
W. D. Rice, P. H. Glatfelter Co., Spring Grove, Pa.
J. Saeman, Forest Products Laboratory, Madison, Wis.



K. W. Britt, Scott Paper Co.; Chairman, Wet Strength and Interfiber Bonding Committee

E. R. Schafer, U. S. Forest Products Laboratory; Chairman, Fibrous Materials Testing Committee

Fred R. Sheldon, Becco Chemical Division, Food Machinery Corp., Station B, Buffalo 7, N. Y.
Arthur Thurn, Champion Paper & Fibre Co., Hamilton, Ohio
R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich.
K. E. Vroom, Pulp & Paper Research Institute of Canada, Montreal, P. Q., Canada

Officers chosen for one additional year were: John F. Langmaid, Jr., chairman, and Maynard S. Renner, secretary.

Professor Beall reviewed the results of the 1954 conference held at the University of Maine, Orono, Me. In spite of a late start in getting the conference organized, attendance had been good and the results satisfactory. He noted some tendency to overcrowd the curriculum in the elementary course. The advanced seminar course had been extremely valuable. It had worked on a group basis, solving one problem per day.

Discussion brought out the importance of limiting the enrollment in the advanced seminar course since the nature of this work, which is essentially high grade consulting, imposed a very great load on the instructor.

Maynard S. Renner summarized the results of a questionnaire sent to those people who had attended the three past Summer conferences. Answers to this questionnaire showed that it was felt the presentation had a high degree of clarity. The amount learned showed a tendency to decrease with the complexity of the subject taught (one respondent maintained that he had learned nothing of any subject). Each of the subjects taught was reported as having received much use and as having much worth to the company by several to many respondents. Interestingly, there was a definite tendency for people reporting little use particularly of the more difficult subjects, to report much worth to the company. Eight per cent of those replying felt that their attendance had been worth less than its cost, 29% that it had returned its cost, 50% that it had yielded a profitable return, and 13% that it had yielded a very profitable return.

Discussion centered around the tendency for those reporting little use of a subject to report much worth to the company. It was pointed out that a little use of statistics may yield great value to a company. R. T. Trelfa pointed out that much of the statistical approach consists of a frame of mind leading to an orderly procedure in planning experimentation and making decisions rather than any specific technique. C. A. Bicking pointed out that a great value of statistics lies in its developing an awareness of the existence and properties of industrial variability.

Fred R. Sheldon reported on plans for the 1955 TAPPI Conference on Statistics. Arrangements have been made for it to be held at the Forest Products Laboratory at Madison, Wis., July 10 to 23, with provisions for residence in Kronshage Hall beside Lake Mendota under very attractive physical surroundings.

The question as to how long these annual conferences should be continued was discussed. It was agreed that they

were in accord with the stated objects of TAPPI, that they were rendering a service to industry, that they now had a momentum and that they should be continued so long as there was a need, expressed in terms of enrollment in each year's conference, from the members of the paper industry.

It was unanimously voted that the Statistics Committee should express through TAPPI its deepest appreciation of the work that Prof. Geoffrey Broughton of the University of Rochester, Rochester, N. Y., had done in furtherance of the objectives of the TAPPI subcommittee on data sheets.

Truman Pascoe was appointed chairman of the subcommittee on Data Sheets. Other committee members are Geoffrey Beall (advisory), T. H. Geiger, T. Ratcliff, and Fred R. Sheldon.

It was agreed to proceed with publication of the two data sheets: Statistical Methods in the Paper Industry and Statistical Control Charts for Basis Weight. These will be turned over to the chairman for submission to the Standards Committee within the next month.

A data sheet explaining methods of coding and randomization with a table of random numbers was suggested. Possible other data sheets were considered and it was agreed that they should, in general, be built around a presentation of good practices in rather advanced mills.

It was brought to everybody's attention that Edward R. Hoffman of the Oxford Paper Co., Rumford, Me., had presented a paper on this subject at the Eighth Annual Convention of the American Society for Quality Control published in "Quality Control Convention Papers 1954" pp. 321–331.

The possibility of a research appropriation from TAPPI to study various phases of this subject was considered. Identifying the distribution of defects was suggested as a simple problem.

It was suggested that paper mills could not afford the elaborate sampling plans some customers will pay for, on the other hand it was pointed out that any sampling plan would cost less, for printing grades at least, than some mills are spending for inspection today. It was agreed that the scope of the sampling plan subcommittee should not be limited to printing papers.

C. A. Bicking reported on the cooperative work that he has been doing with the Testing Division. This program is aimed at developing a statement of precision that can be included in the description of test methods, i.e., a statement of the limits within which two tests from two different laboratories should fall.

This project is recognized as a big one—a major job—statements of precision must be expressed in such a way as to be useful. The committee agreed that this study would be recommended as a subject for a research grant from TAPPI. A Subcommittee on Precision of Testing Methods was established and C. A. Bicking was appointed chairman.

The desirability of having quality levels for paper set on the basis of realistic statistically developed standards was again considered. It was recognized that this is an exceedingly important problem but no further action was taken by the committee.

The chairman reported that the committee members have been surveyed with respect to the question of whether or not the Statistics Committee more properly belonged in the Testing Division. The general consensus was that the Statistics Committee more properly belonged in the Research and Development Division since the use of statistical methods encompasses much more than testing.

C. A. Bicking pointed out that he acts as a clearing center among various groups interested in articles on statistics in industry, notably: The TAPPI Statistics Committee, the Chemical Division ASQC, the Industrial Quality Control Bibliography Editor, and the *International Journal of Abstracts on Statistics in Industry*. Consequently he would very much appreciate receiving notices and preferably abstracts of any articles on paper industry applications of statistical methods which may come to the attention of members of the TAPPI Statistics Committee.

MAYNARD S. RENNER, *Secretary*

Pulp Testing Committee

The meeting of the Pulp Testing Committee of TAPPI was called to order immediately after luncheon, Jan. 10, 1955, at the Monticello Hotel in Longview, Wash., by Chairman Frank Caskey. Also in attendance were: A. M. Cadigan, Elmer Christoferson, James d'A. Clark, W. F. Cyrus, Norval Magnusson, and Otto Sangder.

Time of the committee meetings was reviewed and it was decided to try meeting in the morning of the regularly scheduled Pacific Section TAPPI meetings instead of the day before.

Committee membership is now as follows:

F. E. Caskey, *Chairman*, Morden Machine Co., 3420 Macadam Ave., Portland, Ore.
J. R. Arthur, Port Huron Sulphite Paper & Pulp Co., Port Huron, Mich.
C. E. Brandon, The Howard Paper Mills, Inc., Dayton, Ohio
A. M. Cadigan, St. Regis Paper Co., Tacoma, Wash.
Elmer Christoferson, Scott Paper Co., Everett, Wash.
J. d'A. Clark, P. O. Box 996, Longview, Wash.
F. A. Delforge, Robert Gair Co., Inc., Uncasville, Conn.
Al Graef, Weyerhaeuser Timber Co., Everett, Wash.
G. C. Kimble, Union Bag & Paper Corp., Box 570 Savannah, Ga.
N. E. Magnusson, Puget Sound Pulp & Timber Co., Bellingham, Wash.
F. P. Moden, Bowaters Southern Paper Corp., Calhoun, Tenn.
R. Roberts, Marathon Corp., Menasha, Wis.
O. H. Sangder, Rayonier, Inc., Grays Harbor Div., Hoquiam, Wash.
H. A. Smith, Mead Corp., Chillicothe, Ohio
R. H. Wiles, International Paper Co., Glen Falls, N. Y.
R. M. Wilkinson, Alton Boxboard Co., Alton, Ohio

Richard Roberts was assigned to the Dirt Evaluation Committee; Chairman, E. Christoferson. William Cyrus was assigned to the Pulp Evaluation Committee; Chairman, N. Magnusson.

A letter from Al Graef concerning the securing and packaging of the reference pulp was read.

Permission had been obtained to use Weyerhaeuser Standard grade pulp for the reference pulp and Frank Hamilton of Everett Pulp and Paper will furnish the "finishing." No cost figures were available for buying the pulp or its packaging. The opinion of the committee was that 5 tons of pulp should be procured and packaged and a cost figure be obtained on that basis. There was no decision on storage of the reference pulp.

Elmer Christoferson, Chairman of Dirt in Pulp Subcommittee, reported on the status of pulp dirt evaluation as follows:

There has been no changes in the dirt evaluation method since 1943.

Eight years ago L. V. Formen, as the result of a TAPPI questionaire, instituted a study of the reproducibility of the TAPPI dirt evaluation procedure and this study was continued to date by R. I. Thieme.

The data collected on a joint test dirt analysis sample by a number of mills was forwarded to the TAPPI Statistical Committee for analysis. The data proved so erratic that nothing could be done with it statistically, but the Statistical Committee has offered help in setting up another round robbin of tests to obtain better results.

Members of the committee questioned the advisability of making handsheets for dirt analysis and thought it advisable to study determining the dirt in the pulp sheet without resorting to making sheets.

The committee also thought the illumination requirements should be studied and a transparent template for dirt comparisons investigated.

Elmer Christoferson is to give a progress report on dirt evaluation at the next TAPPI testing conference at Springfield, Mass.

Norval Magnusson, chairman of the Pulp Evaluation Sub-Committee, reported on projects which he thought should should be given consideration. The report and related discussions follow:

Many difficulties with TAPPI methods are due to non-uniformity of testing equipment and it was indicated methods should be more specific in specifying apparatus and there should be some check on manufacturers making equipment specified in TAPPI methods.

A survey of the usefulness of the various methods should be made and tests needing modification be changed.

A form-letter, dated Dec. 10, 1954, sent out by A. J. Winchester for the Testing Division concerning data available on reproducibility of TAPPI procedures and possibility of setting up a round robin series checking reproducibilities was read. The consensus of the committee was that information would not be reliable without a vast amount of cross checking.

A method for moisture in pulp prepared recently by the Testing Committee of the Australian Pulp and Paper Industry Technical Association was discussed. The work done by the Australians indicated the American boring method gave consistently $^1/_2\%$ less moisture than the British and Scandinavian wedge method, which was shown to more closely indicate the true moisture. It was pointed out that an attempt had been made in the past to discard the boring method without success and that actually the error was not serious as long as it was consistent and the only result of changing the method would eventually be a slight adjustment in pulp price. It was also pointed out that for groundwood pulp the boring method indicated a $^1/_2\%$ wetter than actual.

An extended correction chart for the Canadian Standard freeness tester was brought up for incorporation into the TAPPI freeness test. There was considerable question raised concerning the correctness of an extended correction chart and no action was taken.

Chairman Frank Caskey brought up the Battelle Memorial Institute Program for discussion. Battelle Memorial Institute is an independent institution doing contract research work. The Institute proposed submitting a research program on testing for TAPPI and asked for an opinion on how useful a miniature 10-in. experimental fourdrinier machine for use in research on paper problems would be. The committee's opinion was that a program based on the standard pulp and TAPPI testing equipment would be of most use. Considerable doubt was expressed on the practical value of most data that would be collected on a 10-in. midget fourdrinier paper machine.

OTTO H. SANGDER, *Secretary*

Wet Strength Committee

Following are the minutes of the Annual Meeting held at the Hotel Commodore, New York, on Feb. 21, 1955, at 2:00 p.m.

The membership of the Wet Strength Committee is now as follows:

K. W. Britt, *Chairman*, Scott Paper Co., Chester, Pa.
L. E. Kelley, Rohm & Haas Co., 5000 Richmond St., Philadelphia 37, Pa.
John P. Weidner, Container Corp. of America, Manayunk, Philadelphia 27, Pa.
Glenn C. Kimble, Union Bag & Paper Corp., P.O. Box 570, Savannah, Ga.
C. S. Maxwell, American Cyanamid Co., 1937 W. Main St., Stamford, Conn.
W. H. Roberson, Hercules Powder Co., Paper Makers Chemical Department, Wilmington, Del.
J. V. Kindall, Barrett-Plaskon Labs, Box 27, Station I, Toledo, Ohio
H. L. Kurjan, C. H. Dexter & Sons, Inc., Windsor Locks, Conn.

Members and guests present at this annual meeting were: K. W. Britt, chairman, W. H. Roberson, J. V. Kindall, N. S. Gruenhut, John S. Moore, John P. Weidner, L. E. Kelley, E. H. Voigtman, H. L. Kurjan, and C. S. Maxwell, secretary. Mr. Britt was unanimously re-elected chairman of the committee.

The principal accomplishment of the Wet Strength Committee in 1954 was the completion of the manuscript for a monograph. This was then published by TAPPI as No. 13 of the TAPPI Monograph Series under the title "Wet Strength in Paper and Paperboard."

The status of the committee was reviewed and it was apparent that a state of quiescence has prevailed since the big job of producing the Wet Strength Monograph was completed. It further appeared that papers covering strictly wet strength subjects would be difficult to secure in sufficient quantity to justify a session at the next annual or at a sectional TAPPI meeting. It was therefore suggested and unanimously agreed that an effort be made to broaden the scope of the committee to include fiber bonding in general, and not only wet strength. Such a scope could include wet and dry strength agents, softening agents, and rewetting agents. Chairman Britt will outline the proposal in an official letter to TAPPI. It was suggested that the name of the committee be changed to "Wet Strength and Interfiber Bonding Committee."

If the scope of the committee is broadened as outlined above, representatives of Scott Paper, Resinous Products, and American Cyanamid indicated that a paper from each might be obtained for presentation at the next annual meeting.

C. S. MAXWELL *Secretary*

Fibrous Materials Testing Committee

E. R. Schafer, chairman, has announced that the membership of the Fibrous Materials Testing Committee for 1955 is as follows:

E. R. Schafer, *Chairman*, U. S. Forest Products Lab., Madison, Wis.
E. G. Ham, John A. Manning Paper Co., Troy, N. Y.
R. N. Hammond, P. O. Box 778, Longview, Wash.
C. E. Hrubesky, U. S. Forest Products Lab., Madison, Wis.
E. L. Lamb, Minn. & Ont. Paper Co. Minneapolis, Minn.
B. E. Lauer, Dept. of Chem. Eng., Univ. of Colorado, Boulder, Colo.
T. A. Pasco, Nekoosa-Edwards Paper Co., Port Edwards, Wis.

Two committee projects are being financed by means of TAPPI Research Appropriations. The status of these projects is briefly as follows:

No. 351. *Species Identification of Wood and Wood Fibers.*—The key developed by B. F. Kukachka at the Forest Products Laboratory for from 175 to 200 North American woods is expected to be ready for publication during the year (1955). The key will be designed for the use of marginally perforated cards and will have the advantage over most keys for the identification of wood species of being capable of expansion or contraction to contain as many species as desired.

No. 502, *Dirt in Wood Chips.*—This project is being conducted at the University of Colorado under the direction of Prof. B. E. Lauer, Head of the Chemical Engineering Department. A number of experiments have been performed, but the work is not completed and the results obtained so far have not been fully evaluated.

During the year the committee completed a method for the detection and measurement of compression wood in pulpwood and submitted it, via the Division Chairman, to the Standards Committee for consideration as a Tentative Standard.

E. R. SCHAFER, *Chairman*

TAPPI's Proposed Reference Pulp Program

FRANK E. CASKEY

For quite some time, and particularly in recent years, a certain interest has been shown in a standard pulp. Numerous TAPPI members have actively endeavored to establish a program whereby a pulp would be available to the paper and pulp industry for reference purposes. In view of this situation, the Pulp Testing Committee of TAPPI has undertaken the problem of setting up a program to supply the industry with a satisfactory reference pulp.

For all practical purposes this program has been developed to a point where it is ready to roll. However, upon the suggestion of some, the program has been held up until it has been shown that there is sufficient interest in it. Therefore, it was considered wise to make an accurate survey to determine whether or not there is a demand for such a program. The purpose, then, of this presentation is to explain the program and to describe its operation in detail, offering suggestions as to its usefulness. In return, the TAPPI Pulp Testing Committee would like you to indicate your approval or disapproval.

THE PROGRAM

The Pulp Testing Committee has tentatively arranged to obtain a machine-dried bleached sulphite pulp. This pulp is to be furnished by a West Coast mill, will be packaged and wrapped in moistureproof paper, sealed with moistureproof tape, and placed in cartons for storage until sold.

Upon receipt of an order at TAPPI Headquarters in New York, one of the packages of pulp will be promptly mailed to the purchaser. The charge for this pulp is tentatively set at $5 to cover the cost of the pulp, storage, and handling.

POSSIBLE USES

Of course, the primary purpose of this reference pulp is to supply a means for comparing various methods of pulp testing. A number of such tests will be listed later, but for now it might be wise to discuss one particular test. The one chosen for an example concerns the $1^1/_2$-lb. laboratory beater (*1*). In this case it is felt that this piece of equipment would become more useful by using a reference pulp in conjunction with the beater.

It is not the intention of this paper to deride this piece of equipment for it has proved quite useful during the past 20 years. However, there is no denying that it is not at all easy to make two beaters produce equal results on the same pulp.

On the other hand, it isn't necessary for two beaters to develop equal test values on the same pulp. However, it has been shown that the laboratory beaters do differentiate different pulps as to their inherent strengths. Torsten Ekstam, (*2*) in a comparative investigation of pulp evaluation equipment used by several European laboratories, showed that all the beating units tested, including the Valley laboratory beater graded several pulps in the same order in respect to strength properties. That is, the unit that developed the highest burst on one pulp developed the highest burst on all other pulps. The Valley laboratory beater didn't develop the highest strength for the pulps, but it did maintain its relative position on the several pulps tested.

In view of Torsten Ekstam's discussion concerning the different beating units, it would be possible to establish a definite relationship of one unit to another by means of a reference pulp. For example, with the use of this pulp, one laboratory on the East Coast can interpret, in terms of its laboratory disk refiner, the test values of a laboratory beater on the Pacific Coast. Or perhaps this comparison can be carried from one country to another, such as a research laboratory in Great Britain could compare its Lampen mill to a pebble mill in an associated mill in Canada.

At this point it will be wise to discuss the method of using this reference pulp. First of all, it has been established that a dried pulp will remain constant as to pulp strength for a considerably long time. Tables I and II show the reproducibility of laboratory beater tests made on a given reference pulp. The variation that does exist occurred partly from the change in operator's technique, partly from the variation of the laboratory beater and, of course, partly from a slight change in pulp. All in all, the over-all variation is within accepted experimental error.

Table I. Comparison of Laboratory Beaters—Per Cent Burst at 400 Ml. CSF

Monthly tests	*Sulphite pulp*			*Kraft pulp*	
	Mill 1	*Mill 2*	*Research lab.*	*Research Lab.*	*Mill 3*
1	92	81	97	132	123
2	95	81	98	133	124
3	95	76	..	135	..
4	..	..	99	125	128
5	..	82	98	126	..
6	96	75	96	133	..
7	..	76	100	125	..
8	..	78	100	132	..
9	94	77	100	126	..
10	94	79	90	128	..
11	94	86	100	122	124
12	..	84	99	124	..
13	..	..	98	128	124
14	..	76	97	132	126
15	..	78	99	129	..
16	..	79	98	129	..
17	..	80	..	..	..
18	..	..	..	..	..
19	..	83	..	..	..
20	..	78	..	..	..
21	..	80	..	..	..
Av.	94.3	79.4	97.9	128.7	124.8
Std. dev.	±1.26	±3.04	±2.52	±3.70	±1.67

Now to discuss the actual method for comparing one beating unit to another. Let's consider Table III which concerns the strength development of two laboratory beaters. The first part of this table concerns the establishment of a ratio between two different beaters by testing a given reference pulp. This reference pulp was dried sulphite similar to that proposed for the TAPPI Reference Pulp. Both beaters refined duplicate samples to 400 ml. Canadian Standard freeness. The mill laboratory equipment developed consider-

F. E. Caskey, Chairman, Pulp Testing Committee; Morden Machines Co., Portland, Ore.

ably higher burst and tear than did that of the referee laboratory. However, a reference ratio can be established by dividing the test of the referee laboratory by that of the mill laboratory. In this case, both the burst ratio and tear ratio equaled 0.895.

In order to determine whether this would work as to predicting the strength values to be expected from one beating unit in terms of tests made on another beating unit, let's refer to the second part of Table III. On a second pulp,

Table II. Comparison of Laboratory Beaters—Tearing Resistance at 400 Ml. CSF

Monthly tests	*Sulphite pulp*			*Kraft pulp*	
	Mill 1	*Mill 2*	*Research lab.*	*Research lab.*	*Mill 3*
1	1.20	1.45	1.14	1.85	1.90
2	1.34	1.38	1.20	1.72	1.90
3	1.21	1.40	...	1.86	...
4	...	...	1.26	1.87	2.05
5	...	1.20	1.28	1.80	...
6	1.18	1.15	1.18	1.66	...
7	...	1.40	1.28	1.79	...
8	...	1.35	1.24	1.62	...
9	1.27	1.44	1.14	1.57	...
10	1.31	1.30	1.24	1.80	...
11	1.20	1.33	1.20	1.58	1.95
12	...	1.31	1.29	1.83	...
13	...	...	1.25	1.77	1.95
14	...	1.30	1.20	1.80	1.95
15	...	1.28	1.24	1.90	...
16	...	1.17	1.17	1.84	...
17	...	1.20	...	...	...
18	...	...	...	...	...
19	...	1.20	...	...	...
20	...	1.18	...	...	...
21	...	1.20	...	...	...
Av.	1.244	1.284	1.221	1.766	1.942
Std. dev.	±0.050	±0.103	±0.047	±0.102	±0.067

both the mill and the referee laboratory refined the respective samples to 550 ml. Schopper-Riegler freeness. The mill beater developed a burst of 128% and a tear factor of 1.5. Now, by using the previously established ratio of 0.895, we can predict that the referee laboratory equipment will develop a burst of 113% and a tear factor of 1.3. Subsequent tests actually showed a burst of 116% and an identical tear figure.

Table III

	Per cent burst	*Tear factor*
Reference pulp (unbleached sulphite)		
Tests taken at 400 ml. CSF		
Tested by mill laboratory	105	1.3
Tested by referee laboratory	93	1.15
Ratio $\frac{\text{referee lab}}{\text{mill lab}}$	0.895	0.895
Tests taken at 550 ml. S.R.		
Special sample		
Tested by mill	128	1.5
Factor	0.895	0.895
Mill results converted to referee laboratory test value	113	1.3
Actual referee laboratory test value	116	1.3

The greater part of this paper has been devoted to the application of the reference pulp in connection with the laboratory beater. As indicated earlier, there are actually numerous other possible uses. To name a few, we can consider the following physical tests: (1) dirt in pulp, (2) pulp brightness and color, (3) ball mill, (4) kollergang, (5) laboratory disk refiner. Also to be considered are the following suggested chemical tests: (1) alpha-, beta-, gamma-cellulose determination; (2) lignin; (3) pitch; (4) pentosans; (5) ash.

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BOX SCORE

With each sample will be sent a request for each user to report to TAPPI Headquarters the test results he obtained on this pulp. These values, as received, will be reported each month in *Tappi*. Only a code number, known to the parties concerned, will be used to identify the mill or laboratory. It most likely will be feasible to list only certain tests, as some tests won't adapt themselves to such an arrangement. In general, however, the test values obtained for each month will be published along with the average to date.

FUTURE POSSIBILITIES

At the present time, it is planned to use a dried bleached sulphite pulp as the reference pulp. Already suggestions have been made to use several pulps. Perhaps the future results will warrant our expanding this service to include several other types of pulp. However, our prime purpose is to establish the program, as we of the Pulp Testing Committee believe the program has lots of merit and will prove to be quite useful. We are anxious to get this program going and to make it available to the industry. However, at this stage, we feel it is important to obtain the reaction of TAPPI members and others. It would be appreciated if those of you who are interested in such a program would write to R. G. Macdonald, Secretary, TAPPI, 155 E. 44th St., New York 17, N. Y. Then we shall know the advisability of carrying on with this program.

LITERATURE CITED

1. TAPPI Standard, T 200 M-45, "Laboratory Processing of Pulp (Beater Method)."
2. Ekstam, T., *Paper and Timber (Finland)* No. 11: 413–428; No. 12: 475–494 (1953); to be published in *Tappi*.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Southeastern

The third meeting of the program year was held by the Southeastern Section of TAPPI at the Francis Marion Hotel, Charleston, S. C., Jan. 14–15, 1955.

The executive committee meeting was held at 4:00 p.m. at which plans for the March 19 meeting at Jacksonville were discussed.

Registration was at 6:00 p.m. followed by the social hour and dinner.

Mr. Pineo, Section chairman, was in charge of the general session and W. C. Chapman was in charge of the program.

This meeting was unique to the section for it emphasized only one topic, "wood." It was questionable how this would be received by a group of primarily technical men, but it can be said now that all who were there have a deeper understanding of the forester and his problems.

Mr. Pineo introduced C. H. Niederhoff, pulpwood procurement manager, for the host mill, West Virginia Pulp & Paper Co., who gave the welcoming address. He emphasized the need for closer cooperation among technical men, management and woods men. Mr. Niederhoff also stressed the need for wood conservation in order to meet ever increasing demands by industry.

In welcoming the visitors Mr. Niederhoff told of the great change in attitude toward wood supply since 1930 when there was such an abundance no one felt any concern to the present when pulp mills are forced to acquire land ownership in order to be assured of an ample supply. Also they have to help the farmer grow better trees; protect these from fire, insects, and disease; improve methods of harvesting; and utilize increasingly available knowledge of forest genetics. Referring to the much publicized Weyerhaeuser report which predicts a consumption of 30 million cords by 1975, an increase of 100% in 20 years, he declared the problem of providing for this increased demand is not one for the foresters alone. Technologists must help by wringing more pulp out of each cord, using hardwoods and cull trees, and also chips from sawmill waste.

The first paper of the evening session was "Teamwork in Forest Utilization" given by L. A. Whittle of the Brunswick Pulp & Paper Co. This paper pointed out the need for development of personnel and impressing them with the fact that things can be done toward the better utilization of existing raw materials. Also the technical man must be instructed to assist in tree conservation and increase his knowledge in forestry.

L. A. Whittle also referred to the Weyerhaeuser report which he said indicates a utilization of 8 million cords of hardwood in 1975. "But the expansion will not end in 1975" he said. In order for the United States to have all the wood pulp it needs from its own forest resources there will have to be teamwork by all concerned. More of the tree must be used, he declared. All uses must be dove-tailed in order to attain more complete utilization of the total fiber harvest. This involves unified marketing of the products of the tree. Each department must know more about the others. Contributive legislation, especially by tax incentives, can help, but what is needed most is to overcome the "can't be done" psychology.

Wood procurement, like manufacturing, involves selling at a profit. One hundred thousand acres of South Georgia woodlands increase at the rate of 5% per yr. Proper management of this resource involves a need for good accounting practice starting with dependable inventory. Aerophotography with expert analysis can establish dependable inventory data, but since land values are constantly rising production must keep pace. We must use what is on the land now. Broadly speaking, 20% of the southern woodlands are producing hardwoods. The maximum sustained yield must cost less than the average market value.

Three slides were shown. The first gave graphed breakdown of a typical south Georgia pine forest in January, 1953. It showed 31% of the acreage in 1-to-10-yr.-old trees; 22% in 11 to 20-yr.; 20% in 21 to 30-yr.; 17% in 31 to 40-yr.; 8% in 41 to 50; and 2% in 51 to 60-yr.-old trees. A curve sloping upward from the origin showed the units per acre for each age. Only the oldest trees exceeded 30 units per acre. And only 31% of the acreage was satisfactorily stocked. By removing only trees more than 40 years old in the first period and those over 30 in the second period the July, 1958, profile would show:

15% in 1 to 5-yr. old trees
31% in 6 to 15-yr. old trees
35% in 16 to 25-yr. old trees
17% in 26 to 35-yr. old trees
2% in 36 to 45-yr. old trees

Stands would range from 0 to 10 units per acre for 1 to 15-yr.-old; 10 to 20 units for 16 to 25-yr. etc. up to 40 units for the 2% in oldest (36 to 45-yr.) trees. On a 35-yr. crop rotation this land would yield 28.7 units per acre, or an average of half a cord per acre per year. But when "fully regulated" by 1988 it should have an equal acreage in each age class and, cutting only 35-yr.-old trees, would average 0.82 unit (1.07 cords) per acre per year.

For profitable forestry we need the best trees on the best site. Then we must use smaller wood. Dropping from a minimum 4-in. diameter to 3 in. means a 25% increase in tree utilization. The cost of the small wood is greatest in the forest. With a suitable means for removing the bark in

C. H. Niederhof, West Virginia Pulp & Paper Co.

L. A. Whittle, Brunswick Pulp & Paper Co.

the woods there could be considerable economy. Pulpwood cannot be larger than 18 in. Logs larger than this should go into poles or sawmill stock. Selection must be at the woods.

We need teamwork between pulp mill operators and woods management. The woods men need to know what the mill can do efficiently in using small sticks, crooked wood, how much benefit would result from removal of bark in the woods, etc. Twenty per cent of our wooded area is bottom land potentially productive of hardwoods. At present growth is balanced by loss. Meanwhile our pine lands are overburdened to supply the demand. Each stand must be cut as the first step to balance production. By 1975 the United States population will be 188 million. If we simply grow in numbers with greater demand on existing natural resources we shall grow poorer and poorer tending toward destitution. But improved technology will bring increased productivity with plenty for all.

"Outside Storage of Wood" was next presented by H. H. Flickinger, of the International Paper Co. This subject is of concern to all paper mills and Mr. Flickinger spoke of the need for managing the outside yard. A limit of 90 days should be placed on the storage of wood if at all possible to do so. The wood should be picked up and moved as often as possible to reduce danger of blue mold, infestation by insects, etc. One suggestion is to close a yard for a day or two to accomplish this. The necessity of efficient wood yard records and inventory was mentioned as the only way to properly rotate this wood and reduce overaging.

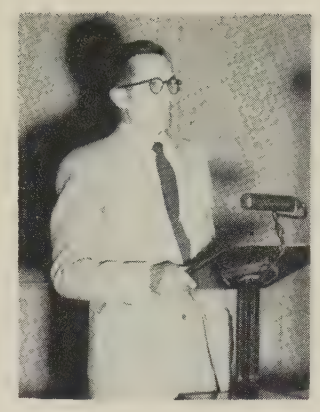
Mr. Flickinger defined "outside" as meaning "beyond the confines of the mill yard." He said that much as the pulp mill operator might prefer always to use freshly cut wood it is impossible to supply this at all times, both because of varying productivity of woods operations and varying demands of the pulp mill. Weather and seasonal requirements for labor in other forms of enterprise as well as varying economic conditions all affect continuity of operations in pulpwood harvesting. Therefore, some provision must be made for "taking up stock." It is more economical to establish wood storage near the source of supply than at the mill site because:

1. As near-at-hand wood is consumed the average wood haul increases beyond the limit for economical trucking. It becomes necessary to transfer from truck to rail. This means handling at least once en route to the mill.
2. For economical handling it is necessary to employ mechanical means such as tractor cranes.
3. For economical operation of these they should be kept busy. They can load cars from storage as well as unload trucks.
4. This can be done only by establishing storage yards, within trucking distances of the woods operations.

Such outside storage has several advantages besides economy of operation. First, its universal adoption by all the pulp mills has stabilized the market price of pulpwood. Second, it permits turning over the inventory on a regular basis thereby preventing deterioration. At Georgetown pulpwood drops 6 to 8% in specific gravity during 4 months of Summer and 3 to 4% during 6 months of Winter.

H. H. Flickinger, International Paper Co.

M. R. Roberts, St. Regis Paper Co.



Barry Malac, Union Bag & Paper Corp.

H. L. Mitchel, Forest Products Laboratory

Generally a 20 to 30 days' supply should be maintained and wood should not be stored longer than 40 days, if possible.

A receiving yard can store a thousand cords per acre if single stacked and about 25% more by double stacking. Trucks are unloaded by half-load slings, i.e., steel cables are passed around each end of a half-load and this sling load is lifted off the truck. The wood is steel banded while in mid-air to retain the sling load entirely. Sticks are placed between these sling loads and sticks underneath on the ground. This facilitates removal of the steel cable sling and its replacement for picking up to load on rack cars. The steel bands are $1\frac{1}{2}$ in. wide by 0.035 in. thick and cost 46¢ a piece. They can be re-used a number of times so the final cost is 2 or 3 cents a cord in storage.

Nobody wants to work in the woods on Mondays or Saturdays. It is good practice to receive wood into storage Tuesday to Friday, inclusive, and load cars from storage the other days.

Following Mr. Flickinger, Mr. Chapman introduced a graduate of the University of Michigan who had joined St. Regis Paper Co., at Pensacola, Stephen P. Kaptain, whose subject was "St. Regis and the Purchased Chip Program."

Mr. Kaptain told how in 1952 St. Regis began buying chips from W. T. Smith Lumber Co., Chapman, Ala. These were from logs that had been barked before sawing and the slabs chipped and screened before shipping. At first the quality had not been up to expectation but was so promising that St. Regis sent an experienced wood room foreman to teach the sawmill operators how to care for the chipper. This has resulted in chips, 90% of which fall in the specified range with 2 to 3% bark and 6.3% (average) larger than $\frac{3}{4}$ by the Williams chip screen test. The chipping operation has been improved by providing horizontal forced feed with hold-down fingers to keep the slabs from jumping. This gives less abrasion of the wear plates and the bed knife lasts longer. Higher disk speeds with fewer knives in the disk have shown better results. A $1\frac{1}{2}$ by $1\frac{1}{2}$-in. top screen is best. St. Regis now keeps a man in the field all the time rendering service to the six sawmills from which they are buying chips at $12.75 per cord of 210 cu. ft. They change knives after each carload (12.5 cords). The cord weighs 4800 lb. at 50% moisture. The sawmills average half a cord of chips per thousand board feet. St. Regis has no investment in equipment at the sawmills.

"We wish we could get enough chips for our full production," Mr. Kaptain said. "This would avoid the outside storage Mr. Flickinger told about."

Answering questions the speaker said they specify not more than 3% retained on 1-in. sieve at least and 80% on $\frac{5}{8}$ in. (Williams screen test). Also if the chips are blue stained they reject the whole carload.

The final speaker on the evening program was Milton R. Roberts, a graduate of North Carolina State College, formerly employed by Hudson Bag & Paper Co., but now with St. Regis, who told briefly of the results of 114 cooks on purchased sawmill chips made in a 4.25-cu. ft. experimental digester. He said the chips make excellent pulp as is to be expected since they come from the outside of the tree. The optimum chip size is from $^3/_8$ to $^7/_8$ in. with as much as possible around $^5/_8$ in. Increased length of chip means greater percentage of screen rejects, but otherwise the pulp is little different. A 10% bark content lowers pulp strength by 50% and also consumes chemical. A 50% moisture content gives higher strength pulp than less than 50% moisture. Diminishing moisture content means higher screen rejects. Fifty more cooks are in process in order to determine the effect of storage.

Replying to a question Mr. Roberts said the pulps were of three types, viz.: liner grade at 32 permanganate number; multiwall bag at 28 permanganate number; and plain bag stock at 23 permanganate number. The pulps had been evaluated according to TAPPI Standards 200 m-45 and 205 m-53, except that the Noble and Wood handsheet making equipment and procedure had been used.

The Saturday morning session began at 9:00 a.m. with the presentation of "Conservation Practices in Connection with Wood Procurement" by B. E. Allen of Union Bag & Paper Corp.

Mr. Allen pointed out that in spite of the fears of some laymen that all the trees would be cut and the mills move out, there has been maintained substantially the same volume of timber over the past 15 years and that the potentially marketable trees has increased. The full text of his paper showing why this is so is given below.

Peter T. Lannan, Jr. of West Virginia Pulp & Paper Co.'s experimental forest gave a paper entitled "Industry's Part in Forest Genetics." Herein was stressed improvement of forests genetically with particular emphasis on the study of plant physiology and plant psychology. Not only must forests grow the most possible per acre per year, but also the best. Mr. Lannan emphasized the necessity of speedy development in various forest projects to meet current and future demand. One requirement is seed from best stands of trees and discriminate cone selection for better and more prolific growth and superior quality of seedlings. Industry can best help by assisting its own tree planting projects.

The text of Mr. Lannan's paper is given below.

"Possibilities for Improving Per Acre and Per Cord Yield by Applying Genetic Principles and Management Practices" was presented by Harold L. Mitchell of the Forest Products Laboratory. The most fertile field for reducing costs in the pulp and paper industry according to Mr. Mitchell is to reduce the cost of the wood. In this paper, special emphasis was placed on wood density and its importance so far as pulp yield is concerned. As density increases, yield increases and low density wood produces only half as much pulp as wood with high density. Mr. Mitchell feels that evaluation of forests and wood should be done on the basis of end product rather than output per year. Increased output does not necessarily mean quality product or high yield for generally fast growing wood has low density. Of course, density varies according to growth conditions, position of wood on tree and geographical location. Genetic factors also influence density. Forest Products Laboratory has, in the last 6 months, developed a method to determine tree densities by boring.

Mr. Mitchell discussed the early difficulties encountered at the Lake City Experimental Station in rooting trees from branches, setting up the most conducive conditions for young tree growth, etc. Throughout the entire paper, however, emphasis was placed on fiber production per acre rather than cord per acre as the ultimate goal for foresters and industry to work toward.

Barry Malac presented the paper "Work at Union Bag in Forest Genetics." This paper was concerned with the gradual growth in forest research by industry in the south. In order to better understand the woodlands problem, industry must have some applied research. Here some of the methods of forest study were brought out and projects being studied by the Woodlands Division of Union Bag. Investigation into the use of various fertilizers for seedlings to enhance root structure and spread roots lower so that the seedlings can survive droughts was mentioned as one of importance.

G. L. Smith, *Recording Secretary*

St. Regis and the Purchase Chip Program

Stephen P. Kaptain

Because of the increase in competition for pulpwood supply in the south, it was necessary for our company to search for a method of utilization of forest products which would insure us of an economic supply of wood fiber. We did not have in mind a source for a cheaper material, but rather the relationship of the industry to the whole field of Southern economy.

Since it had been estimated that only one third of the wood from a tree cut for sawlogs was marketed as a finished product, and that the waste available for chipping approximated 0.5 cord per thousand board feet, our company embarked on a program of procuring chips manufactured from clean sawmill waste.

In 1952, we took a major step forward in using sawmill chips at our Pensacola plant when an agreement was reached with the executives of W. T. Smith Lumber Co., Chapman, Ala., to produce chips from clean sawmill waste. They installed an Andersson mechanical log debarker, Soderham chipper, and a vibrating screen. This debarker works on the principal of removing bark by means of a rubbing action of pneumatic pistons tipped with stellite blades.

Chips were first delivered to Pensacola in February, 1953. This first car of chips was an eye opener. Although the quality did not meet our specifications, it did show the tremendous possibilities in a properly controlled operation of this sort.

In the beginning, the two items that caused us the greatest concern were bark content and oversize chips. The bark amounted to approximately 4% by weight, and the chips retained on the $1^1/_8$-in. screen around 12%. In order to improve chip quality at Chapman, it was necessary to acquaint them with the effects of low quality chips in pulp yield and pulp quality. Our woodrooom superintendent and pulp mill superintendent spent considerable time in supervising the sawmill men in the proper knife setting, importance of sharp knives and bed plates, always stressing the fact that all sawmill waste was not suitable for chipping. The results were gratifying, and proved to us that with the proper instruction the sawmill operators could produce chips comparable in quality to our normal chip production.

To better illustrate the progress accomplished during this period the author would like to mention that the bark percentage averaged 0.6 of 1% by weight, and the chips retained on the $1^1/_8$-in. screen approximated 6.3%, from analysis reports on a total of 80 cars. However, the author would like to point out that it had taken 9 months to effect this improvement, and the success in lowering the bark percentage resulted from improving the log debarker mechanically, and the experience gained by the debarker operator during this period.

From this experience in procuring chips from outside sources and with the hope of increasing our purchased chip program, we felt that it was most important to us at this time to devote the necessary time to the development of a better method of chip preparation.

We all understand that when pulpwood is prepared at the pulp mill for digestion complete quality control is possible. A close check on chip production is maintained and necessary

Stephen P. Kaptain, St. Regis Paper Co., Pensacola, Fla.

precautions are taken to insure uniformity of chip size; minimum of fines, sawdust, and oversize chips; and clean-cut chips. This is possible because trained personnel with the proper equipment can maintain the chippers to do the job required by the pulp mill.

However, we all understand that when chips are procured from outside sources, quality control will be reduced because the human element in chip production is multiplied by the number of suppliers. Therefore, we believe that in order to guarantee a high quality chip production, we had to investigate the type of equipment that was to be made available for this purpose, the problems that would be encountered with the different machines, and the practicality of using this means for supplementing our mill's wood fiber requirement by this method of wood conversion.

The machinery investigated included: (1) disk chipper with horizontal forced feed, (2) disk chipper with horizontal and vertical feed, and (3) hog-type chipper with horizontal forced feed.

Best results were realized with the horizontal forced-feed disk chipper. Material was fed directly into the disk so that it had positive feed both into the disk and directed against the bedplate. There was no vibration of material being chipped. When the knife opening was set for a $^5/_8$-in. chip, 90% of the material received from the chipper was within $\pm^1/_{16}$ in. of this knife setting. The amount of oversize material, splinters, and sawdust were at an absolute minimum.

Too much bouncing contributed to lack of uniformity in chip length and a high percentage of rejected material from the operation of the disc chipper in a vertical position. This same chipper on a horizontal plane produced an improvement of chip quality, but the production was not as desirable as that experienced after hold-down fingers were installed in the spout. The hold-down fingers created the same effect of the forced feed mechanism and the chips were of a high quality.

The hog-type chipper production lacked uniformity, chips were short in length, with a great variation in chip width. This was due to a churning action of the chipped material before being discharged.

Our investigation pointed to the following factors to be considered in selecting machinery to insure economical and efficient performance of chippers:

1. Horizontal feed facilitated arrangement of wood on conveyor, and curtailed to a minimum twisting and jamming of wood in the spout.
2. Length of slabs are no problem with the horizontal feed, and savings could be expected with this type feed because you could eliminate chutes, slashers, and reduce the height of conveying structure.
3. The horizontal forced feed produced more uniform chips since the wood was conveyed to the disk at the rated feed speed of the chipper rather than the variable velocity reached in sliding down a chute.
4. In order to produce quality chips, the action of the knives to the bed knife should be such that scissors action in cutting the slab is accomplished rather than a chopping action. The bed knife also lasts longer.
5. The bed knife should be set so that it could be turned end for end and over, to provide four edges for wear before replacement is necessary.
6. Removable and adjustable wear plates should be standard on chipper disk. The wear plate would absorb the shock of the wood passing into the chipper, and would eliminate expensive disk replacement.
7. To facilitate conveying of chips to screen, chippers that are equipped with removable fans attached to the back of disk to blow chips would eliminate installation and maintenance of mechanical conveyors.
8. Chipper construction should be such that maintenance would be simplified. Knife changing and setting should not be time consuming and difficult.
9. Economical production is obtained by higher disk speed and the fewest number of knives.
10. Horsepower requirement should not exceed 100 hp. in order to insure economical operation; except in cases of the larger sawmills where available waste is so much greater and larger chippers are required.

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11. Size of spout opening should be big enough to take 95% of the material available for chipping.
12. Knives should be changed every 16 cords or once for each car loaded.

The next step in developing a more satisfactory method for chip preparation was in connection with screening. Where we use a 2 by $1^1/_2$-in. opening in the top screen cloth at the mill, we found that the oversize chips from outside production from this type screen was in excess of specification requirement. With a smaller mesh top screen cloth $1^1/_2$ by $1^1/_2$ in., we experienced a decrease in the amount of oversize material being delivered to the mill.

After screening, we found that car loading is economically performed by using a screw conveyor or valve-type feeder to introduce chips into an air conveyor. The chips are blown into the car without any damage to the chips since they do not pass through the fan.

At the Pensacola plant, the chips are unloaded by a laborer who scoops out the door area with a pitchfork and completes the unloading with a payloader. For the amount of chips being unloaded today, this system is satisfactory. But, when production increases appreciably, we will go to a hopper-type car for chip shipments. Unloading will be accomplished by means of an overhead car shakeout attached to top of hopper cars. The chips will be dumped into a pit and conveyed to storage by belt conveyor.

During the unloading, specimens are taken every 15 min. from the conveyor taking the chips from the unloading hopper to storage. Thus we get a representative sample of chips from each car for purpose of analysis. By this means, we keep a close check on chip size, bark content, and moisture content. Copies of the analysis reports are distributed to the chip producer; and items that do not meet our specifications are underscored and commented on. This helps to highlight these particular points and results in a greater effort on the part of the chip producer toward continued improvements.

We feel that with the information we have assembled and experience gained over the past 2 years, we are better equipped to insure high quality chip production from outside sources. We keep a man in the field to help prospective suppliers with chipper installation and to furnish necessary instructions on how chipper should be operated. These outside suppliers are entitled to all the assistance we can give them because this is a new field for them; and if the chips are not satisfactory; not only do they lose money, but we cannot maintain our quality standards.

We all realize that this program is in its infancy, and too, it is a highly important one. We feel that we have made great progress and we expect to exert all efforts toward continued progress in this new field of wood utilization by the pulp and paper industry.

Conservation Practices in Connection with Wood Procurement

B. E. Allen

This opportunity of meeting with the Southeastern Section of TAPPI to discuss some elements of pulpwood procurement, conservation practices, and forestry is most welcome. As a professional forester employed by the industry, it has always been my feeling that there needed to be a freer exchange of information between the various segments composing our operations. Only by exchanging ideas, thoughts, and methods, and being mindful of the other fellow's problems, can we achieve the desired machination of a fully integrated operation, turning out quality products at a minimum of expense with maximum profits.

One of the questions most frequently asked of foresters by the uninformed layman is: "When are all the trees going to be cut?" As a matter of fact, the problem of source of raw material has always been of interest to industry management and to those technicians concerned with the conversion of trees into marketable products. This particular interrogation has been going on for the past 17 or 18 years, almost since the pulp and paper industry began its original building program here in the south. Many of you who were employed in this area in the mid-thirties remember some of the lay comments which were to be heard with regard to the operation of our mills. Considerable conjecture was made that the mills would locate—cut all the trees—then get out. Certainly our attendance here today is positive refutation of that conception.

Without burdening you with a great deal of statistics, it can be said that a comparison of surveys made by the U. S. Forest Service in 1934–35 and repeated again in South Carolina in 1947, in Florida in 1949, and in Georgia in 1953 definitely establishes that there is approximately as much timber by volume growing today as there was in the mid-thirties. This has come about despite the tremendous growth and expansion of the pulpwood industry and the enormous drain imposed by the lumber industry during the war years and the postwar building boom. However, there have been shifts in the amounts of timber in the various diameter classes. For instance, there is less sawtimber sized trees, *but without exception*, the number of small trees has increased quite significantly. Small trees include those in the 4, 6, 8, and 10-in. diameter classifications.

To appreciate the impact of what this increase in small trees means, when viewed with an eye to the future, we need only recall a very fundamental rule of mathematics learned years ago. The area of a circle increases as the square of its radius. With proper fire protection, management, and conservation practices, this basic arithmetical formula will convert this vast reservoir of young trees into available raw material not only for the pulpwood industry, but for lumber, poles, piling, fuelwood, cross ties, fence posts, veneer bolts and a myriad of other forest products afforded by our timberlands.

There have been those pseudo-social planners who have consistently prophesied gloom and despair over the future of our forest resources. There have been acts of legislation introduced in the Halls of Congress which would require the strict control and regulation under federal decree and the licensing of all cutting on privately owned timberlands. However, we will not pursue these differences of opinions and the answers thereto here this morning. Suffice it to say, we have not run out of trees and timber.

The maintenance of substantially the same volume of timber over the past 15 years and the increase in potentially marketable trees is not a happenchance situation. It has come about as a direct result of markets, laws of economics, and the awareness on the part of management of large wood-using industries, that measures must be taken to grow trees and to recognize them as a renewable crop. Lending a helping hand, as the occasion arose, to landowners with forestry problems has also contributed.

It has only been in the last few years that many landowners with timberland acreage have recognized the significant fact that they possessed valuable treasures which, if properly cared for and treated as a growing crop, would pay steady dividends. There are today many examples of men who only a few short years ago were classified as "land-poor," they were pressed for operating capital, and worried as to how they would pay their ad valorem taxes. Today, they are millionaires when measured by any monetary yardstick, and they are still worrying over taxes—only this time it is income taxes.

How did this all come about? Here are a few reasons why we are growing more trees today than ever before, why forest products are such an important segment of the economy of the states represented here today.

In the three states of Florida, South Carolina, and Georgia there exists the greatest concentration of pulp and paper mills ever assembled in a similar sized area. In 1953, they produced 6 million cords of pulpwood, or 21%+ of the total consumed in the nation, with a resultant production of pulp in the same per cent of total of United States production. As an example, Alaska has been hailed as one of the newest and greatest potential pulp producing sections of the North American continent with considerable publicity as to its capacity. Yet there exists in the city of Savannah, Ga., alone, a production of pulp equal to the stated potential of all Alaska.

This market has had a profound impact on the growing and selling of trees. Without exception there is not a county in the forested sections in either of the three states represented here where a landowner cannot find a ready market for his pulpwood and other forest products. Many times his available markets are multiple and he finds himself in the enviable position of picking his buyer, and he has the added advantage of selling to the one with the high dollar.

The competition for wood is bound to result in some overcutting, and this matter is of concern to each of you, whether you be charged with growing the trees, shipping the pulpwood, running the machines of conversion, or selling the product in the channels of commerce.

It is recognized by the industry that all of the cuttings which result in wood being shipped to the consuming mills do not reach the standard of forest practice which is most desired. This past year, there was a sampling program conducted by the member mills of the Southern Pulpwood Conservation Association, which is an organization of the principal pulpwood industries in this area, in which the sampling was based on the number of cords cut without reference to the acreage. One sample was made for each 7000 cords of production for each member on noncompany lands. Wood cut on company lands is not sampled. Classifications established by the Association are land clearing, clear cut, seed tree, partial, thinning, and salvage. Each is self-explanatory, except perhaps for partial and thinning. A cutting is classified as partial when there remains a maximum basal area of 40 sq. ft. per acre, and a thinning when the residual basal area exceeds 40 sq. ft. For those of you who might be wondering what basal area is, it is the number of square inches of actual trees on an acre and is arrived at by calculating the area of the trees at stump height by multiplying πr^2. Then by using random numbers, the producer to be sampled is selected. The number of samples taken this past year amounted to 1450 on a south-wide basis. It is a mathematically sound system and a known degree of accuracy can be obtained.

The results for 1953 showed wood cut from noncompany lands as follows: land clearing 16%; clear cut 25%, seed tree 19%, partial 16%, thinning 16%, and salvage 8%. It is a serious matter for all of us to consider that approximately 41% of the cuttings fall in the category of unwise forest

B. E. Allen, Union Bag & Paper Corp., Savannah, Ga.

management, whether dictated by the owner or otherwise. Land clearing, however, to change land use does rest with the individual owner. This is still America and each individual can exercise his own prerogative with regard to how he handles his land, but it goes out of wood production as surely as the clear-cut areas.

This matter of unwise cutting practices on land owned by private owners is one that is receiving a great deal of attention by our industry. One of the most effective antidotes for overcutting is the services of conservation foresters whose principal duty, in many cases the sole duty, is to work with landowners advising them on matters of forest management, fire protection, reforestation, utilization, and other problems of the wooded acre. These men are available for marking trees on the farm woodlot to be cut on a selective basis in thinning or improvement cuts. Last year approximately 9% of the pulpwood supply in the south was marked by such personnel. There were 126 such men employed as technically trained conservation foresters. Ninety-five additional nontechnical trained woodsmen functioned as marking aides. You might be interested to know that there are 753 graduate foresters on the payroll of the industry here in the south functioning in all categories. It is to be expected that the amount of timber volume marked by the industry's conservation personnel will increase year by year.

Any forestry report on our three states always points up the number of acres of idle land that should be planted and put in productive tree growth. During the last tree planting season (1953–54) the industry was responsible for the planting of $44^1/_4$ million trees in Florida, $42^1/_4$ million in Georgia, and $11^3/_4$ million in South Carolina, and substantial quantities of these seedlings were given to interested private landowners free of charge for planting on their own lands. These trees were sufficient to reforest 140,000 acres of idle land. For the south as a whole in the last seven tree planting seasons, we planted $585^1/_4$ million trees, with $144^1/_2$ million going to small landowners with our compliments. Last year over the south the total trees planted was $180^1/_4$ million, an increase of 52 million over the preceding year. It is interesting to note that over 48% of the trees planted in the entire south last year were planted in Georgia and Florida.

The over-all problem of getting vast numbers of small landowners to practice good forestry is being attacked from many quarters. There are reams of educational materials published each year by individual mills and by industry associations. These leaflets, pamphlets, and booklets all graphically point out the returns available to those who cut wisely and practice fire protection and prudent forestry. One company has effectively employed the comic book field to tell its story and this booklet has received widespread favorable comment as to its content, message, and accomplishments.

Exhibits, many ingeniously planned and designed, are receiving more and more attention each year. The county fairs, forest festivals, Keep Green Weeks, and similar observances offer excellent opportunities for display. Elaborate dioramas employing three-dimensional effects have been used, together with technicolor slides, flashing pictures, and sound effects. In every instance, the message is the same: Protect from Fire, Grow Trees, Harvest Wisely, Make Money.

A number of companies have prepared beautiful films, telling the story of the forests, their care and wise use, and productiveness. Many of these films are works of art and both instructive and entertaining. They lend themselves admirably to civic club luncheons, to the further education of plant visitors, and in various other ways.

One educational program rather unique and almost exclusive with our industry is the forestry camps held during the Summer months and lasting from 2 days to a week. These forestry camps provide fundamental forestry instruction and education to rural youths. In many instances the instructors are industry employed foresters. A youth attending one of these camps cannot help but go away with a deeper and keener appreciation of a tree, and with more than a passing knowledge as to how it grows, how it should be managed, protected, harvested, and more fully utilized. Of equal importance, the youngster is aware, for perhaps the first time in his life, that the pulpwood industry is a good citizen interested in the future of the country. We should be ever mindful of the fact that these freckle-faced, snaggle-toothed bundles of energy today will be landowners tomorrow, growers of trees, and sellers of pulpwood.

Many of you have noticed in recent years the increase in number of news articles, pictures, and publicity items that have been appearing in the press, both newspapers and magazines. These effectively bring to the notice of many readers what is being done to foster work. One recent news item that elicited widespread comment was the picture of an 85-year-old farmer planting a field of pines—with this caption. "I'm planting for the future," said the landowner. Too much emphasis cannot be placed on the importance of timely, newsworthy, and well-written press releases.

Many conservation foresters use woodlands demonstrations to convey the meassage of good forestry to landowners. Attendance at these may vary from 5 to 500. In any event, those attending are exposed to the indisputable fact that trees are a crop, with recurring profits to those who plant idle acres, protect from fire, and cut wisely. It has been observed, however, that the trend is away from the mass demonstrations to more specific attention in the woods to the problems peculiar to the landowner's individual timberlands.

You might be interested in a rather new approach to educating farm youths being used by a company in Georgia—the Future Farmers of America school forests, in cooperation with the Vocational Education Department. The idea of school forests is not new for some have been in operation for as long as 18 to 20 years. It is novel that a company would sponsor a series of these forests, not only on their own lands, but on other lands as well; provide the technical supervision and instruction necessary; and create a series of substantial prizes as recognition for good work. These school forests serve as a laboratory, where the students observe the results of thinning, fire protection, and reforestation. They practice wise utilization, marketing, and harvesting. They carry on home projects where they can put into use on their own lands the pointers learned in school. And as a result each year over 3500 young men become very well acquainted with the elements of forestry, preparing themselves to become better landowners and forest farmers when they graduate. You would be amazed at the quantity and quality of the work accomplished on these projects. For instance, the young man who recently won first place in the home project contest had these accomplishments:

Planted 16,000 pine seedlings
Plowed 5700 yards of firebreaks around the family woodlot
Marked 37 acres for thinning
Pruned 3 acres of pines
Cut 50 fence posts for creosoting at the county prison camp
Constructed the following forestry tools: fire rake, fire swatter, tree caliper, rack to store tools, Biltmore stick
Mapped forest acreage improved during the year
Collected 25 bushels of pine cones which he sold for a nice profit
Attended all classroom sessions on forestry
Spoke to PTA, chapel assembly and FFA Chapter concerning his forestry projects
Attended a summer camp for a week studying forestry
Made leaf prints of 35 native trees and labeled the prints

You no doubt will agree that this young man is well on the way to becoming a successful tree farmer.

It is an age-old maxim that if you know your neighbor's problems you will understand him better. This thought prompted several of the mills in this area to invite the county agents and teachers of vocational agriculture to visit their plants and to be their guests at forestry seminars where industry representatives and their guests exchanged ideas and discussed the problems of the small landowners who in the main

pays little or no attention to the future of his forest. Carefully planned lectures and field demonstrations served to acquaint the visitors with the latest techniques of reforestation, mensuration, utilization, harvesting, fire protection, and related problems. It is certain that both host and guest derived a great deal of benefit from this exchange of ideas and became closer friends.

The awarding of scholarships and fellowships for the study of forestry both at college and graduate levels has been incorporated in the programs of many mills in this section. Many students now attend college who might not otherwise be able to avail themselves of a higher education. This program will benefit the schools and at the same time provide an increased number of graduates conversant with some of the problems facing industry today. It could also prove to be a worthwhile reservoir of young men for possible employment by the industry as considerable thought and attention are directed toward the selection of the recipients of these grants for college study.

There are many other individual efforts by the various mills which fall in the category of trying to better the source of supply of their raw material and to insure its existence over the years to come. All of them, together with the ones which we have specifically mentioned, represent conscientious effort on the part of industry management to assure the future of this section and to shoulder their equitable share of the social responsibilities in bringing this about. The money and manpower to implement all of these programs are no small item in the annual budget. You can rest assured it is not merely set up as window dressing. It is a calculated effort, warm and friendly, to show the populace *what*, *why*, *when*, *how*, and *where*, and *who*.

You no doubt have read of the Stanford report which was made by the Stanford Research Institute at the request of the Weyerhaeuser Timber Co., whereby a projection could be had of America's demand for wood through 1975. Without going into the specific details of how this fine report was developed, we can recognize it as one of the most dramatic stories of our generation, and particularly for those of us who are interested in our American forests, since it marks the first time the wood-using industries have made a determined effort to prove the wood future in terms of their own enterprises.

This report makes these interesting forecasts:

1. The United States pulping industry will require 47½ million cords annually by 1975, as against 24½ in 1952.
2. Of total 1975 production, 9.4 million cords will come from mill waste, as against 1.5 million today.
3. The domestic requirements for saw timber in the United States will increase only 3.4% by 1975.
4. Hardwood utilization will increase from 14.3% in 1952 to 26.3% in 1975.
5. The south will remain the principal area of supply, with 30 million cords in 1975. In 1952 we used only 14½ million.

This report certainly points up the fact that the pulp industry is on the move with tremendous expansions and increases in store. It also represents a challenge to us to redouble our efforts at conservation and wise cutting practices. We must think of new approaches to the problem, new techniques, new methods, and retain vigor in our tried and true performances. To be sure we will be aided in many ways. A considerable portion of our predicted requirements will come from mill residuals. Hardwood utilization is expected to vastly increase, thus enabling the silviculturist to convert pine hardwood types to pure pine, thus increasing pine supply. The research expert and the geneticist will team together to develop strains of trees which will give trees of desirable density, growth rates, and size in shorter growing periods. New methods will become evident in cutting practices which will point the way to bigger volumes and higher quality trees on shorter rotations.

Perhaps some forester or engineer will develop some means of mechanization whereby the amount of hand labor involved in the preparation of pulpwood bolts or logs can be reduced, thereby delivering the wood to the mill site cheaper and more effectively. This must be done if the industry is to keep pace with competitive materials. Today about 75% of the cost of raw slush pulp is in the cost of the wood. An analysis of the cost of the wood reveals a large proportion attributable to labor—labor for cutting, hauling, and unloading. Reductions of production costs are just as effective conservation measures as thinning, partial cutting, and reforestation.

The rapid development of the off-plant woodyard as a method of wood procurement imposes new burdens. A woodyard can be likened into another small mill drawing wood over a 25 to 30 mile radius. This concentration of cut will seriously deplete the reserves of timber in that area unless suitable provisions are made for the future. A source of seed, fire protection, prudent cutting, and harvesting is all that is needed.

Those of us using the contractual system for wood purchases must be careful to deal with men who think of the future—men who insist on leaving seed trees, and not "cut it all as fast as you can." We must eliminate the nonconformist to the idea that no area will be cut unless it meets the minimum standards set by the industry.

Let me summarize by saying that some of the prophets of gloom have had their predictions dashed because they overlooked the simple fact that trees do grow. While billions of cubic feet of wood have been consumed, the industries are aware of the need of conservation wise use, and the promotion of methods of tree growth, and more billions of cubic feet of timber are on the way. The venturesome have peeked into the future and have predicted on the best known facts of today what the years ahead will hold, all of which adds up to the fact that industry is planning, thinking, and doing something about its problems. However, the demand on individual effort will be greater than ever before. The challenge is just as sharp as that of yesteryear, yet the rewards hold promise of being even greater.

And best of all, without fear of contradiction, it can be predicted that the earth will continue to rotate on its axis, the seasons will come and go with equal regularity, the rains will fall and the sun will shine, and the bountiful soil and a generous Mother Nature will continue to give forth their rich fruit providing for you and I, our children, and our grandchildren. There will be plenty for all. The only requirement of Mother Nature is "just give me half a chance."

Industry's Part in Forest Genetics

P. T. Lannan, Jr.

In treating with such a subject as "Industry's Part in Forest Genetics" we might well consider why the sudden interest in forest genetics and what we man by forest genetics.

Forest genetics has suddenly become very popular. During the past four years the interest in this subject has increased tremendously. This is not because forest genetics is a new subject. Doubtless it is almost as old as forestry itself. As near as we can determine current interest developed something like this. In 1949 the World Forestry Conference was held in Helsinki, Finland. Many American foresters attending that conference took the opportunity to view the forestry activities of Europe. Apparently the one thing that impressed them most was the work in tree improvement and forest genetics. Returning home these foresters talked tree improvement and forest genetics at every opportunity. They found an interested audience in foresters and landowners who were feeling the burden of ever increasing costs of owning and managing forest land. Many had started practicing "forestry by the acre" to get maximum production on the land they controlled. Now forest genetics, an old subject re-evalu-

P. T. Lannan, Jr., West Virginia Pulp & Paper Co., Charleston, S. C.

ated, offered to be an important tool in making forest production still more profitable.

P. T. Lannan, Jr., West Virginia Pulp & Paper Co.

In view of these developments J. Herbert Stone, Regional Forester of the Southern Region, U.S.F.S., called a meeting on tree improvement and genetics at Atlanta Jan. 9 and 10, 1951. That meeting gave birth to the Southern Forest Tree Improvement Committee, the first of its kind in the nation. Now there are similar committees in all major forest regions of the United States. These committees have in a very large measure been responsible for the sustained and increased interest in tree improvement activity. Interest is still increasing. The author is sure you will hear more of tree improvement and forest genetics.

As to what we mean by forest genetics let us consider it here, as all those varied activities that are aimed at improving the genetical makeup of our forest. Under such a broad definition, cutting a tree in a stand of timber, because species, form, disease, or insect attack make it an undesirable, is a positive genetical act. The genetical makeup of the stand has been improved by removal of an individual that produces undesirable chromosomes, consequently undesirable progeny. At the other end of the scale we include basic or fundamental research in such fields as plant cytology and physiology as they apply to forest genetics. Perhaps it is because the field is so broad that the southern committee elected to call itself the Southern Forest Tree Improvement Committee. Certainly this broad consideration includes controlled breeding, testing of progeny, grafting, vegetative propagation, seed orchards, seed production, selection of superior trees, testing of exotics, and many many other areas or branches of forest genetics and related activity.

We take for granted and give little thought to the really great improvements that have been attained in the agricultural field through applied genetics. For a long time forest managers had little interest in such intensive practices. Now with forest products more valuable, cost of purchasing and managing land climbing ever higher foresters must aim at using their forest land to the very best advantage. Every acre must grow not only the most possible but the best possible products that are the objective of the management. If it is pulpwood we can no longer be satisfied with cords of pine per acre per year. We will have to go further—we must grow the maximum usable fiber per acre per year. Forest genetics is the tool that will help attain that goal. Tailor-made trees of extra fiber length, extra density, and extra rapid growth may be some time in the future. That requires much work in selection, controlled breeding, and testing of progeny. In trees that takes time; it takes years. It also takes money. Little of this type of research work will be done by industry but much of it can and must be supported by industry. The gains stand to be tremendous. Mr. Mitchell doubtlessly will give ample coverage to this area of the subject.

Because the gains stand to be so substantial industry must support and cooperate in research in tree improvement and forest genetics. It can ill-afford to stand by and let developments come at a slow pace. Support and cooperation is needed in the basic research that is the essential foundation of the tailor-made trees of the future. Financial aid is needed for much of this work. Pleas for such assistance are coming in many forms from many institutions and organizations. Care should be taken to be sure that monies are allocated where they can be used to buy the best research.

A first step in developing tailor-made trees is the location of superior individuals to be used as the breeding stock. Industry can render a value service in locating and reporting such individuals. Our plantings for progeny testing will be made. Seed orchards will be established. Industry must cooperate in these activities and make planting sites available either through active participation or through cooperative agreements.

Doubtless you are thinking we are still talking about future activities—what can industry do now? As is usually the case it can do most by helping itself in the own program—its own tree planting program. To illustrate let us consider a study carried out by P. C. Wakeley of the Southern Forest Experiment Station. This study was carried out near Bogalusa, La. Seed was obtained from four sources and grown in the same nursery. The 1-yr.-old seedlings were planted on the same sites. Seed sources and growth per acre are as follows:

Volumes per Acre of Loblolly Pine Plantations at Bogalusa, La., Established from Four Different Seed Sources

	Location of seed source and distance from planting site	*Volume per acre yield (cords)* — *15 Years*	*22 Years*	*Cords per acre per year*
1.	Louisiana—50 miles west southwest	14.2	41.8	1.9
2.	Texas—350 miles west	8.8	22.7	1.0
3.	Georgia—450 miles east northeast	6.5	17.7	0.8
4.	Arkansas—350 miles north	6.3	15.4	0.7

Think of it. Seedlings from local seed grew nearly twice as fast as the Texas seed and nearly three times as fast as the Arkansas seed. This plantation demonstrates that within the natural range of a tree species there are definite geographical strains. These strains probably reach their best growth and development within definite geographical limits. The best seedlings for a forest owner to plant are those raised from seed gathered in the very best stands on or near his ownership. This must be accepted until other races or species are proved to be superior to the local seed source. Industry in its planting program can help itself and the advance of tree improvement if it will be sure the trees it plants are grown from seed of known source.

There is another story regarding tree seed that is appropriate. In the Fall of 1949 Westvaco Experimental Forest was very happy to grant permission to a group of high school students to collect loblolly pine cones from their sawlog operation. They were very much surprised when the leader of the group returned in a short while. Expressing his thanks he added "The trees you are cutting are too long and lean. They have a small top and only a few cones. If you get into some short scrubby stuff with lots of cones let us know." Short scrubby stuff with lots of cones!

Those cones were to be sold to the state nursery. Foresters at the experimental forest began to wonder just how much of the seed the state used came from "short scrubby stuff." This incident occurred about the time that Keith Dorman of Southeastern Forest Experiment Station and some other foresters in the south were beginning to talk forest genetics and tree improvement. Westvaco foresters in a search for a practical means of getting seed from a good source hit upon the "seed orchard" idea. (Later by definition the Southern Forest Tree Improvement Committee changed this to "Seed Production Areas.") Using such qualities as form, disease resistance, branching habits and growth as recommended by Dorman (*1*) areas supporting superior stands were selected. These areas were marked and cut leaving 10 to 25 of the very best individuals for seed production. The other trees in the stand were sold for piling, sawtimber, and pulpwood. Earlier studies of seed fall on areas cut to seed trees had established

that release of tree crowns to full sunlight would stimulate flowering and cone production so that bumper cone crops could be expected the third and fourth growing seasons after the release. At that time when cones are ripe the trees are cut and cones harvested.

Westvaco Experimental Forest has demonstrated that loblolly pine seed can be produced in seed production areas at below the market price of seed (*2*). But even if it cost considerably more, such seed when custom grown in the state nursery has definite extra value because it comes from the best stands in the locality in which it is to be planted. At least one important pulp and paper company in the south has adopted this seed production idea. After 1956 all loblolly seedlings planted by this company will be custom grown from seed grown in seed production areas. Meanwhile they are collecting cones from superior seed trees left in logging where reproduction has become established. Cones so harvested are either sold to the nursery as cones or thrashed out and the seed sold as seed to the nursery. In either event seedlings are custom grown for the company. Both parties are happy with the arrangement. The State nursery has a reliable source of supply for a large portion of its seed. The company obtains seedlings of known origin. Custom grown seedlings are sold to the company at the regular price.

Do not the two stories just related give the reason and point the way for industry doing something right now? Forest genetics is not only something for the future it is a tool at hand to be put to use now. Further research and developments are needed so that it can be used more and more effectively.

To actively take its part in forest genetics, industry, particularly executives, foresters, and those responsible for forest management must realize the importance of work in this field. Their support is essential to speed research and to develop early answers. Custom growing of seedlings from seed collected from superior trees is a first step up the latter of good genetical forestry. Cooperation with and support of the technical aspects of research will bring tailor-made trees. Progress may not be as rapid or spectacular as in the agricultural crops or the flowers. But industry interest, support, and activity will speed the progress. And the gains stand to be tremendous.

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1. Dorman, Keith W., Heredity Variations as the Basis for Selecting Superior Forest Trees, Southeastern Forest Experiment Station Paper No. 15 (1952).
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Kalamazoo Valley

Printers and papermakers got together the afternoon and evening of March 3 at the Hotel Harris, Kalamazoo, Mich., in the Graphic Arts Conference sponsored by the Kalamazoo Valley Section of the Technical Association of the Pulp and Paper Industry.

Starting at 1:30 p.m. and continuing to 5:30 p.m., a symposium and discussion drew a very clear picture of how, in our competitive system, one customer enforces his demands for quality upon his supplier, and that supplier, in turn, is a customer who puts pressure on those who sell to him. The result is a constant effort toward progress, and the customer is king. On the other hand, the great difficulties were described which must be overcome daily merely to maintain present standards of quality. All raw materials are variable to some degrees, especially those, such as wood fibers, which are products of nature. On top of these variables are the human variables, and in addition, there is the fact that paper machine equipment and printing press equipment are always continuously changing while in use. Printing plates gradually wear and, on long runs, eventually must be replaced. Presses

Part of head table, Graphic Arts Conference of Kalamazoo Valley Section of TAPPI, March 3, 1955, at Hotel Harris, Kalamazoo. Left to right: John Langmaid, Harry Hadley, R. W. Wilkerson, W. C. Granville, J. A. Dean (Chairman of the Section)

act differently when they are warmed up as compared to when they start. Paper machine felts and wires, and beater and jordan fillings never stay the same, but are continually in progress from new condition to where replacement is necessary.

It was agreed that in recent years vast progress has been made by papermakers in meeting demands of printers. Less paper is rejected today than 10 years ago, and press performance has improved. However, there is much room for improvement, as evidenced by variation in printed results and by occasional gross defects such as torn edges and foreign materials, which can cut down press production and sometimes damage the presses. The need was emphasized for standardization and for narrower tolerances in specified properties, especially in view of today's high-speed presses, which make more stringent demands upon paper quality.

In this symposium, Robert W. Wilkerson represented the advertisers and the advertising agencies in showing what they want and need in appealing to their customers. He stated that advertising lineage has doubled since 1946 and now represents $420,000,000 per year. Dwight Monaco represented the printers, and voiced the demand for better standardization. Abe Lewenstein spoke on behalf of the technical men of the paper mills and remarked that customarily every property of paper represents a compromise between conflicting needs and desires. Harry Hadley defended the papermakers, calling attention to the many variables, but at the same time he asserted that progress will be made by technical men and superintendents aiding and supporting each other. Mr. Langmaid, as a quality control supervisor in a paper mill, pointed out that as yet no direct measures have been invented for many of the sheet properties which influence printed results.

Following a dinner at 6:30 p.m., Walter Granville spoke on "Order and Confusion in Color." In spite of advances in instrumentation, the comparison of colors is still done best by the human eyes. To aid in the description of colors, the Ostwald and the Munsell systems were devised. As applied,

Symposium members: Harry Hadley, John Langmaid, R. W. Wilkerson, A. Lewenstein, and D. L. Monaco

these systems provide orderly sets of color chips, and comparison against these chips is done visually.

Mr. Granville made several remarkable demonstrations to show that color interpretation is largely mental, and that, therefore, our judgment of a color is influenced by the background of the color. He showed also how color is influenced by illumination, by distance of the observer from the color, and by the effect of gloss. Two pictures, identical in every respect except gloss, were markedly different in appearance, the glossier colors looking much brighter.

The meeting featured a large number of exhibits of printing plate manufacture, of ink, and of printed work, both finished work and work at various stages of progress.

J. A. Dean presided, and R. T. Trelfa was moderator, introduced speakers, and was general chairman of the meeting.

ROBERT T. ELIAS, *Secretary*

Discussion—R. W. Wilkerson

I came to the Kalamazoo Valley to receive my first indoctrination into the paper business. Today, as a first order of business, I find myself addressing a group of papermakers. A rather strange start for one who knows nothing about the paper business but a very pleasant one. . . I am very glad to be here.

My experience and training, as Dick Trelfa told you, has been in the advertising business. Under today's rather severe criticism of advertising, most people in the business travel under assumed names and stick to the back alleys. My feeling, however, is that advertising, which has told everybody else's story so well, has been a poor spokesman for itself. It mumbles quiet apologies and retires in confusion in the face of criticism. Actually, it has an exciting and positive story to tell.

As case in point, the paper and board coating industries are a direct result of the impact of advertising on the consuming American public and more particularly the growth of the advertising agency business.

By this I do not mean that it was the advertising agencies alone which caused the growth and diversification of the coating industry. But it was the advertising agency which was the prime mover in the need for more and more coated paper and board.

Many years ago advertising was done by the media—that is, the individual magazine prepared the ads. They were usually all type with perhaps a pen and ink drawing or a wood cut. At this point the advertising agency was born.

Originally the advertising agency was a kind of magazine space broker. The agency, usually an individual, would buy, let us say, 10 pages of space in the April issue of a magazine, then proceed to peddle these pages to advertisers for whatever the traffic would bear. As the magazine neared issue date, the page prices would get less and less—it was no business for anyone who didn't also like to bet on horse races. Many grew rich but most lost their shirts.

To outdo the rival space agents, different ones began adding services such as help with artwork, copy, and so forth and slowly the agency business grew.

As it grew, it stabilized and gained stature, its job became defined, it had to sell products—more and more products to more and more people against more and more competition. The agency business developed techniques of presentation. It demanded color in art and photography—it demanded cleaner, clearer, more exciting pictures of products—it demanded packages that would make the customer reach for the product and buy it.

These demands could not be met on uncoated papers alone. Coated sheets of better and better quality were a must. Coated board became mandatory for point-of-sale impact.

A hand-in-hand development with the growth of agencies becoming involved in the packaging, selling, and merchandising of products was the almost complete revolution in retail selling—the development of self-service and the consequent de-emphasis of the man behind the counter.

There are many, myself among them, who have shed a tear at the passing of the corner grocer. I feel the regret most keenly when I find myself on the business end of a cart trying to pick up some groceries—but that is progress, and you gentlemen are the beneficiaries of the growing need for smarter and smarter point-of-sale merchandising which results from this progress.

And the growth has been tremendous. Just since 1946 the number of self-service supermarkets has more than doubled, revenue from gas stations (another great place for product merchandising) has better than tripled. In 1953 gas stations rang their cash registers to the tune of better than 10 billion dollars. Sounds almost like the national debt, doesn't it?

And let's take a look at some other figures where the advertising agencies have helped with the demand for coatings . . . in business papers for instance, that is, nonconsumer type magazines.

Since 1946 advertising lineage has better than doubled and now represents $420,000,000 per year. To go back a bit further, there is an interesting comparison to make. In 1935 approximately 15% of trade magazine advertising was agency prepared and the dollar volume was $51,000,000. Today about 95% of trade paper advertising is agency prepared and the volume, as I mentioned, is 420 million dollars.

Let's take a look at consumer magazines. Magazine lineage in just the last 5 years has grown better than 15% and now stands at a record high of 50,000,000 lines per year. It is interesting to note here that this is the greatest percentage growth in magazine history and that it came at exactly the same time as the growth of television. Some people said that television would kill magazines, but the facts have shown that magazines have grown and that television has served to add new impetus to point-of-sale merchandising. This country has a wonderful way of always making room for the new and keeping the old.

With that short history and those few figures as indications, you can see how the advertising agencies have helped create the demand for more and better coated paper and coated boxboards. But agencies, as with any business, are, after all, just people.

What do these advertising people really know about paper technically? It is rather amusing that there is so little real knowledge of paper at the level where the large majority of it gets purchased or specified in a general way.

Plans and programs that run into campaigns costing 5 to 10 million dollars, and along the way may entail the use of 2 to 4 million dollars worth of paper, are decided upon and contracted for by a group of people whose total knowledge of paper extends no further than, "Let's see this on a nice heavy sheet of shiny paper."

Further down the line, of course, there are people who have the technical knowledge to turn these ideas and requests into concrete productions, and especially when you move from the agency to the magazine and printer, you find people who know. This you will find with the next speaker who has been and is one of the recognized production men in the broad field of advertising, Dwight Monaco of McGraw-Hill.

But to sum up on how an advertising man thinks about coated papers and board, it perhaps is best said that he thinks only in terms of the results he wants to achieve, and he has practically no concern about or interest in the tools that it takes to achieve those results.

The advertising man at the client contact level—and this is where the decisions to spend or not to spend are made—together with the client, decide almost every matter that will ultimately dictate the use of a large tonnage of paper and boxboard.

Except in rare cases, neither of these people has any knowl-

edge whatsoever of paper. Printability, double coating, varnish hold-out, pic,—these words mean nothing to them.

At first glance this might seem to be a condemnation of the paper industry's selling ability. They haven't reached these people with their story.

But rather than an indictment of the paper industry, I feel it should be taken as a high compliment to the ingenuity and creative ability of the paper industry, because every demand of the advertising man has always been met by the paper industry. He need have no concern about whatever flights of fancy his imagination may carry him. Every fancy to date has been made possible.

Of course in doing so we have probably added a few gray hairs to you people in the paper business, but remember the advertising business has also built the sale of preparations to cure the "prematurely gray."

Discussion—A. Lewenstein

Mr. Wilkerson told us what he wants in the way of end results. Mr. Monaco described how he tries to get them. The question now is: what qualities must the paper have to get these results? Since this is a graphic arts meeting what I say will be confined to those qualities related to the printing operation. My experience further limits me to printing on conversion coated papers.

Let us assume that we are starting with well-designed copy, excellent plates, and inks made primarily to bring out the best there is in the plates. Essentially the printer's job is to obtain a faithful reproduction with maximum contrast between highlights and shadows. Working in the best tradition of craftsmanship (which he shares with the papermaker) the printer would like to think only of the customer. Being merely human and obliged to make a living he must turn out this reproduction with maximum contrast at a modest profit. In other words he must buy the paper at the right price and get it printed at less cost than he figured the job.

Faithful reproduction requires a surface which is completely smooth, if not originally, then at least under printing pressures. A printing job strives to convey an illusion of reality. The vividness and conviction of this illusion depends primarily on the range of contrast that can be created by the print. In practical terms this depends on two things: the brightness and opacity of the paper and the strength and purity of color of the ink. High strength ink usually means stiff tacky ink. Exact reproduction demands that the area of the printed dot shall be no larger than the plate dot. This too, calls for stiff ink. Stiff ink means strong paper.

Suppose everything has been right so far and there is a faithful reproduction in terms of *wet ink*. The next essential is that the absorption of liquid from the ink by the paper be both uniform and correct. If not uniform more vehicle will be left in some areas than others and the gloss of the image will be nonuniform producing a mottled print. Correct absorption means that the right quantity of vehicle is removed at the proper rate. This is a large subject. Very briefly stated too slow absorption promotes offsetting. Excessive absorption results in chalky printing and other ills generally classed under ink drying problems.

The modest profit our printer seeks may well elude him if he can't run his presses at the rate he used in figuring the job. Since he has to use stiff ink to get the best looking job, that, coupled with good printing speed, again means strong paper. If this is a multicolor job the paper must have dimensional stability against both mechanical stress and moisture change. By all means, too, the paper must not curl.

Even if cost were no object it would not be easy to include all the desirable properties in one sheet of paper because many are contradictory. What the printer finally gets is a compromise which may be good or indifferent depending on the knowledge, skill, and resource of the organization making the compromise.

To attempt even the briefest mention of all the ingredients and methods that determine the compromise would be far beyond my scope. With your leave I shall mention a few at random which may serve as a starting point for the discussion that follows the speakers. Since printing is our primary interest let us start with the area of direct contact—the coating.

As everyone knows the function of the coating is to obtain a more level and more uniformly absorbent surface than can be obtained without it. The coating consists of pigments and adhesives. Theoretically it is supposed to fill in all the irregularities of the base paper so that no matter how uneven the side of the coating next to the base paper is, the top side is smooth and level. Actually the theoretical is only approached, sometimes remotely, sometime more closely, but is never reached.

By far the most important pigment is clay. Prior to the advent of machine coating clays were sold largely on the basis of color, finish, and adhesive demand. Machine coating forced an extensive study of the rheological properties of clays because the range over which the new process could then be operated was vastly narrower than conversion coating. I would like to suggest that conversion coating could also be benefited by a similar study.

If I were speaking anywhere else I would hesitate to use the word rheology. But this being the home town of Harris Ware and Dick Trelfa, rheology must be the commonest of household words.

The adhesive in a coating plays a twofold part. First, it holds the dry coating together and binds it to the base paper. Second, it has a dominant effect on the rheology of the wet coating. There has to be enough adhesive to fulfill the first part so the coating will not pick in printing but too much detracts in three ways: by loss in brightness, by reducing the rate and uniformity of ink absorption, and by making the coating less plastic. The latter hinders the effect of calendering. It also makes it harder for the paper to yield and make contact under printing pressure. Strictly from the point of view of quality, that adhesive is best of which the least is required. On that basis the commonly used adhesives line up in about this order: casein, the latices, isolated soy protein, starch. It should be noted that the latices do not detract from the plasticity, in fact they increase it.

If the adhesive remained distributed throughout the coating as it is at the moment of application several problems would be avoided. It seems likely that in actual practice there is considerable segregation. This may leave zones poorer or richer in adhesive than the theoretical average. If the poor zone is at or near the coating-paper-interface a deep coating pick may result. If the poor zone is near the surface a slight dusting may result. This is offered as a possible explanation for the appearance of a coating deposit on the blanket of an offset press after a number of impressions even though the paper passed all ordinary tests for quality. Zones rich in adhesive may occur at the surface and reduce the rate of vehicle abstraction from the ink. Again this is offered as one of the possible causes for excessively uneven ink absorption sometimes observed on coated surfaces.

No matter what its composition or flow properties or how it is applied, coating tends to follow the contour of the base paper and to penetrate into it in a more or less nonuniform manner. The papermaker and coater do their best to prevent this: first, by manipulating the base paper and, second, by controlling the rheology of the coating. Another attempt which is gaining momentum is to apply several coats. This procedure undoubtedly can give good printing surfaces.

If the formation of good coated surfaces is controlled by the variables so far described then I would like to suggest that it should be possible to make single coated papers that would print at least as well as double coated.

It is common knowledge that the best coated surfaces can-

not be made without a lot of help from the base paper. To be good for coating, base paper must be well formed. By this is meant that the basis weight distribution from point to point across the web as well as in the machine direction should be held within close limits. How close? Certainly better than the ±5% tolerance now generally accepted. While there are a number of other essential attributes good coating stock must have they can be summed up under the heading of uniformity and basis weight distribution is probably the foundation of all.

Several times the need for strong paper has been mentioned. Unfortunately it is hard to make paper strong and very well formed at the same time, especially if production has to be kept up. This is one of the contradictory requirements mentioned earlier. Another is related to getting dimensional stability for, let us say, offset papers. To resist distortion from mechanical forces the paper should be strong in both directions. This property can only be attained by relatively strong fiber-to-fiber bonds. But such paper will have relatively high expansion with moisture increase. To be relatively stable to changes in moisture content paper should be beaten as little as possible, have the largest tolerable difference in strength between machine and cross direction and in general have as low fiber-to-fiber bond as the other requirements will permit.

There seems to be a vast amount of excellent, beautiful, printing around. Robert Reed once told me that European printers find it hard to believe that United States printers get the effects they do with only four impressions. This must mean that generally the papermaker does a good enough job so the printer can turn out fine quality work. Examples of such work, the study of which can be both pleasant and instructive, are the numerous efforts to portray the charms of American womanhood.

Ohio

The Ohio Section of TAPPI held its sixth meeting of the 1954–55 season at the Legion Hall in Middletown, Ohio on Feb. 10, 1955. Over 200 members of the Ohio section were present to hear Marvin C. Rogers, director of research, R. R. Donnelly & Sons Co., discuss "Printing."

Chairman Harold Joiner, Champion Paper & Fibre Co., Hamilton, Ohio, opened the meeting and introduced Thomas Zentner of the Gardner Board & Carton Co., who arranged the evening's program.

M. C. Rogers, R. R. Donnelly & Sons Co.

Mr. Zentner introduced Mr. Rogers, who discussed "Printing and Paper." Mr. Rogers pointed out that there was a very definite need for better understanding between the paper manufacturer and the printer. Since both have common problems, many of which cannot be technically answered, Mr. Rogers felt that close cooperation and understanding between the industries is essential.

After Mr. Rogers' timely paper, the Ohio Section was privileged to hear a talk by Doyt Perry, backfield coach of Ohio State University. Mr. Perry also showed movies of the Rose Bowl champions in action. This film was made available through the courtesy of B. L. Hanna, Corn Products Sales Co.

All those present found both Mr. Rogers' paper and Mr. Perry's talk extremely interesting, and everyone went home more conscious of both printing and football.

March Meeting

The Ohio section of TAPPI held its seventh meeting of the 1954–55 season at the Manchester Hotel in Middletown, Ohio. Over 150 members of the Ohio Section were present to hear Richard S. Hunter, of Hunter Associates Laboratory, discuss "Optical Instrumentation."

Chairman Harold Joiner, Champion Paper and Fibre Co., Hamilton, Ohio, conducted a short business meeting, after which he introduced William Gutzwiller, Maxwell Paper Co., Franklin, Ohio, the member of the Program Committee who arranged the meeting.

Mr. Gutzwiller then introduced Mr. Hunter, who presented a paper entitled "The Potentialities of Instrumental Measurement of Appearance Properties of Materials."

Due to the ever-increasing demand for paper with uniform properties, this paper was very timely and interesting. A summary of Mr. Hunter's paper follows.

E. W. Petrich, *Recording Secretary*

The Potentialities of Instrumental Measurements of Appearance Properties of Materials

Richard S. Hunter

Although great strides have been made in the development of photoelectric light detectors and electronic measuring devices, instruments for measuring important visual properties of papers and other materials must be used with care and intelligence. Color, gloss, transparency, and the like are not unique properties of materials with specific numerical values as are weight and chemical composition. Instead, they are visually recognized aspects of complex optical situations.

The eye is so agile and efficient in its ability to detect familiar optical clews that the complexity of some of its habits is not appreciated. It is an extremely sensitive comparato so that sensitive instruments are needed to equal its comparative ability.

Ignoring dimensions and markings, the appearance attributes of uniformly colored materials divide into color which is attributable to spectral selectivity in reflectance and transmittance, and geometric aspects such as gloss which are attributable to geometric selectivity. Both color and geometric factors of appearance vary with geometric conditions of illumination and view. In addition, color varies with spectral conditions of illumination. It is thus feasible to obtain and use specifications of color reflectance and gloss covering only a few standard observing situations.

At present, quantitative procedures for measuring and specifying the appearances of materials are largely confined to laboratories rather than production facilities and the channels of commerce. Some specific attributes of certain materials are regularly identified by specification. Examples are: luminous reflectance and hiding power of white paints, brightness (blue reflectance) and opacity of papers; and gloss of paints, papers, and plastics in all but the high-gloss range.

The group at the February meeting of the Ohio Section

W. O. Gutzwiller, Maxwell Paper Co. and R. S. Hunter, Hunter Associates Laboratory

Instrumentation to implement these and other less widely used specifications must be diligently supervised or systematic errors of measurement will creep in. Color specifications are held back by the fact that only the most careful measurements by spectrophotometry have the absolute accuracy necessary to identify colors with eye's precision for color matching.

Thus, most appearance attributes of most products are still graded visually against standard samples in spite of the unsatisfactory permanence of such standards and the lack of objectivity of visual observations. Instruments may be used to supplement such visual control by providing quantitative data on the permanence of standards and by providing permissible tolerances. Measurements may also be used to check the acuity of the inspectors who make the visual judgments. Noteworthy advances have been made in the quantitative identification of color differences. The NBS unit of color difference (sometimes called the judd for Mr. Judd who created it 17 years ago) is a unit of small color-difference perceptibility corresponding to the maximum difference permitted in certain textile dye matches. It is practical to identify quantitatively the required closeness of color match to standard sample.

In this connection, the recently developed photoelectric tristimulus colorimeters such as the Hunter-Gardner color difference meter, the du Pont Colormaster differential colorimeter, and the PPG-IDL Color Eye are well suited for measurements of small color differences. It should be pointed out that measurements of small color differences are somewhat less accurate than many measurements. A measure of a small color difference in NBS units will frequently be uncertain by a factor of two. The chief sources of this uncertainty are lack of photometric precision of the measuring instruments., their failures spectrally to duplicate the CIE standard observer, and the difference between the various formulas, each designed for use with a specific type of instrument.

There are a variety of gloss scales, each applicable to surfaces of a given type. A paper, "Gloss Evaluation of Materials," published in the *ASTM Bulletin* for December, 1952, describes the presently standardized gloss test procedures and the types of surfaces to which they apply. A recent TAPPI paper, "Gloss Tests for Paper Products," describes the problem of gloss measurement in the paper industry. For gloss instruments, Hunterlab will shortly offer a glossmeter adaptable to all the established gloss test procedures as well as to new ones now being devised for high gloss and texture. Gardner Laboratory, Photovolt, and Manufacturers Equipment Corp. also offer glossmeters for sale.

Mr. Hunter addressing the Ohio Section meeting

Empire State (Northern District)

The Northern District, Empire State TAPPI, held its monthly meeting on Feb. 10, 1955, at the Hotel Woodruff in Watertown.

S. Young, Crown Zellerbach Corp.; W. Gallay, E. B. Eddy Co.; Elizabeth Case, Secretary; L. M. Lyne, E. B. Eddy Co.; and Roger Schwartz

Seventy-one members were present and enjoyed a talk by Wilfred Gallay, research director of The E. B. Eddy Co., Hull, Que., on "Inter-Relations Among Properties of Paper."

Mr. Gallay discussed these properties in two classes:

One, the things we can now measure continuously on the paper machine or will be able to in the near future, and, two, those properties which it is not yet feasible to measure continuously.

In the former class, the speaker listed: moisture content, basis weight, thickness or caliper, density, porosity, formation, dirt content, opacity, gloss, and curl. Instruments for measuring some of the above are now available commercially and for the others, equipment will be available in the not too distant future.

In the second classification, Mr. Gallay placed several properties directly related to strength: burst, tensile, tear, and fold; and discussed the complex relations between these properties. He discussed the concept of the stress-strain

curve and the need of examining the prefailure behavior of a sample rather than simply noting the breaking point.

The speaker also called attention to the "neglected third dimension" of paper, the thickness.

Following the talk, questions from the floor were answered by Mr. Gallay and L. M. Lyne, research chemist of The E. B. Eddy Co., who accompanied Mr. Gallay to Watertown.

(Miss) Elizabeth L. Case, *Secretary*

Empire State (Eastern Districts)

The January meeting held at Milfranks on the Lake George Road on January 20 was called to order by Chairman Grant Cole at 8:15 p.m.

Minutes of the December meeting were read and approved, followed by a report from the treasurer.

In the absence of Vince Long, program chairman, Mr. Blandy of The Blandy Paper Co. was introduced and presented the speaker of the evening, R. C. Reed of the General Electric Co. Mr. Reed gave a very interesting paper entitled "Suggestion Systems and Aid to the Technical Division." Mr. Reed distributed leaflets and pamphlets published by General Electric as an outline of their suggestion system.

The meeting was adjourned at 11 p.m. following a question and answer period.

February Meeting

The Febuary meeting was held at the Queensbury Hotel in Glens Falls on Febuary 17 and was called to order at 8:20 by Vice-Chairman Earl Johnson.

Minutes of the January meeting were read and approved. Mr. Johnson introduced Walter James of Marinette Paper Co. as chairman for the Junior Award Papers. Mr. James explained the Junior Award setup and urged that the various companies encourage at least one member of their organization to present a paper.

Vincent Long, program chairman, announced that the program originally scheduled for February, namely "Agricultural Fibers," would be given at the March meeting which will be held at the Queensbury on March 17. Mr. Long then introduced the speaker of the evening, Jay G. Weidman of the W. H. and L. D. Betz Co. of Philadelphia, who gave a very interesting paper entitled "The Use of Filming Amines in the Paper Industry."

Following a question and answer period the meeting was adjourned at 9:50 p.m.

Richard J. Collins, *Secretary*

Empire State (Central District)

The Central District of the Empire State Section of TAPPI met at 7:00 p.m., March 4, for its monthly dinner meeting. There were 102 present.

Seated at the head table were F. G. Sommerville, chairman, Empire State Section; Carl H. Swartz, speaker; F. W. O'Neil, chairman; D. W. Geffken, vice-chairman; S. E. Church, treasurer; and Mrs. B. H. Wortley, secretary.

Professor O'Neil introduced those at the head table. George Martin, Ives Gehring, and C. P. Donofrio were appointed to the Central New York Nominating Committee. The meeting was then turned over to Mr. Geffken.

Mr. Geffken introduced the main speaker, Carl H. Swartz, of the Sales Department of the Beloit Iron Works.

Mr. Swartz gave a very excellent talk on "What's New in Paper Mill Design." He spoke in particular of the advances made in paper mill machines built since the end of World War II. The increase in paper machine speeds has been outstanding. Many factors have made this increase possible. Some of them are: new designs in headboxes, more efficient water removal by table rolls, very basic changes in press sections, changes of machine drives.

F. G. Sommerville, Armstrong Cork Co.; C. H. Schwartz, Beloit Iron Works; B. H. Wortley, Solvay Process Div.; F. W. O'Neil, State University of New York, College of Forestry; D. W. Geffkin, Oswego Falls Corp.

The changes in press section design have been very important. The open draw between the couch and the first press had been one of the primary drawbacks to increased speed. This problem was licked by the use of pickup felts.

"All in all," Mr. Swartz stated, "the changes in making paper since the end of the war has outstripped advances in any other time. More paper companies are spending more time and money on experimental processes and technical aspects. The paper industry should continue to grow as in the last few years."

An interesting question and answer period followed Mr. Swartz's talk. Some of them were:

Q. What is your opinion of welded driers versus cast iron driers?

A. The principal discussion point is heat transfer through the material. Steel has better transfer than cast iron. Taking B.t.u.'s into consideration, the biggest loss is in the insulating layer of air between the sheet and the drier. Of the total energy lost, only a small part is attributable to drier material. Cast iron can now be made to take steam pressures to 160 lb. Only a few papers can take this. There is a definite advantage to steel if these high pressures can be used.

Q. How does this apply to Yankee driers?

A. There is no insulating blanket of air on a Yankee. Changes in heat transfer are therefore more important, but steel driers are liable to go out of round. Steel can also rust or scale inside and cause hot and cold spots.

Q. Are faster sheets giving up suction couches?

A. Plain couches are used in specific light weight sheets. As the speed goes up, the sheet tends to go straight through.

Q. What about hot presses marking sheets?

A. Markings were apparent on several machines, but finally have been licked by felt suppliers.

Q. What limits the practical size of a Yankee drier?

A. Shipping difficulties limit the size of the Yankee. Also, the shell thickness must be increased to go from a 10 to a 12 ft. Yankee so that in most mills they must be running at peak efficiency to get their money out of a change from 10 to 12 ft.

Q. What is the importance of the hood?

A. There have been many changes in hoods for Yankee driers. Now, they not only exhaust but are also piped with hot air to step up drying efficiency. The recent change in hoods in general has been to enclosed hoods. This is of particular importance in lightweight sheets. It is possible to completely control the movement of air around the machine. The exhaust can also be much smaller. These hoods are still at atmospheric pressure, not under a vacuum.

Q. On fourdrinier machines for food containers, we first sized and now coat on one side. When will we go to double coat?

A. The machinery and the know-how are now available. It will be done when the customer demands it.

Q. On a cylinder machine is there merit in suction press, plain press, suction press?

A. Yes, a lot of merit in alternate arrangement.

Q. Can changing felt grades lick the shadow marks on pressure rolls or Yankee?

A. No.

Q. Are we doing anything with secondary headboxes on fourdriniers?

A. Yes, quite a trend in the south now. They are now looking toward putting on a bleached top layer with secondary headboxes.

(Mrs.) Barbara H. Wortley, *Secretary*

The following paper was presented at the February meeting of the Central District.

Construction and Operation of Flat Screens to Obtain the Maximum Screening Efficiency and Speck Removal from Various Pulps

H. F. Schenk

Since the influx of the various foreign-made screens such as Ahlfors, Lindblad, Vibrotor, Cowan, and LaMort, the people promoting the sale of these are stressing and emphasizing the limited floor space required to screen 1 ton of pulp per time interval per square foot of floor space. These are pressure-type screens, depending upon high-frequency vibrations of the screen cylinder submerged in a tub bath of heavy consistency pulp, the high-consistency pulp being pushed through the slots of the plates, and over-size particles passing out with the rejects.

In the recent 1954 *Tappi* magazines containing the technical published papers of 1954, you can find a complete text of the papers covering these various screens, including the author's most recent paper on "Selective Particle Separation by Controlled Fluid Forces on a Flat Screen." This was published in the Juiy issue of *Tappi*. All of these papers were presented at the Alkaline Pulping Conference in Houston, Texas, on Nov. 20, 1953. We suggest that you who are interested in the screening of pulp, read the articles on these various types of screens—then read or study the following story on the mechanics involved in creating the controlled fluid forces on a flat screen.

Please let me suggest that in attempting to diagnose the meat of these enclosed papers, that you begin with the analysis chart, Table I—this one is fairly up to date, but when we first used it, 56-plate lines were fairly common. We did not recognize the importance of the foot flow per minute forces of the flow of pulp over the screen. Once we found

H. F. Schenk, Magnus Metal Co,, Fitchburg, Mass.

F. G. Sommerville, Armstrong Cork Co.; D. B. Geffkin, Oswego Falls Corp.; H. F. Schenk, Magnus Metal Corp.; F. W. O'Neil, New York State College of Forestry, and Ives Gehring, Oswego Falls Corp.

the importance of knowing these figures, especially the velocity point at which laminar flow broke into turbulent, or turbulent slowed down into laminar, we had a safe starting point.

After finding this factor, the next thing was to build into the headbox and flow approach the necessary flow spreaders, head height regulating baffles, and slope or pitch of the screen to keep this laminar flow within its safe limits and its most efficient flow velocity—where the time dwell between the strokes of the diaphragm worked most efficiently with the gravitational forces ever eager to help the flow of good pulp through the slots.

This field is in need of much more study. The Sprout Waldron Co., is making a laboratory screen with drive variables that may produce some interesting data on these forces.

To date, on a stroke of 1/8-in. amplitude, 580 strokes or pulsations per min., working on a surface flow of 180 f.p.m. over a 28-plate screen, has given us some very efficient screenage capacities.

The charted capacities shown in Table II are an illustration of what one mill found in charting the efficiency of the flow

Table I.

Plate and dilution water positions

	1 – 2	3–4	5–6	7 - 8	9–10	D.W. position	11–12	13–14	D.W. position	15–16	17–18	D.W. position	19 20	21 22	D.W. position	23–24	25–26	D.W. position	27 28	29–30	D.W. position	31–32	33–34	D.W. position	35 36	37–38	D.W. position	39 40	41–42
Drainage area in square inches per plate																													
Style milling																													
Number of slots per inch																													
Size of slot																													
Length of stroke																													
Number of strokes per minute																													
Depth and width of flow over outlet dam																													
Area in square inch of diaphragm outlet																													
Distance from bottom of plate to top of outlet dam																													
Consistency on plate																													
Consistency of accepted stock																													
Speck count																													
Freeness check for fine and coarse fiber																													
Velocity over first 14-plate section																													
Velocity over second 14-plate section																													
Velocity over last 14 plates																													
Average velocity over 42 plate length																													

Table II. Screening Test on Unbleached Sulphate

Laminar flow, screen no. 1					Turbulent flow: Screen no. 2					Turbulent flow: Screen no. 3					Turbulent flow: Screen no. 4				
Dam no.	Plate cut	Consistency, %	Pounds oven-dry pulp 24 hr.	Shives per gram	Dam no.	Plate cut	Consistency, %	Pounds oven-dry pulp 24 hr.	Shives per gram	Dam no.	Plate cut	Consistency, %	Pounds oven-dry pulp 24 hr.	Shives per gram	Dam no.	Plate cut	Consistency, %	Pounds oven-dry pulp 24 hrs.	Shives per gram
1	0.014	0.48	8954	66	1	0.014	0.25	2841	370	1	0.014	0.27	2712	170	1	0.014	0.23	3148	249
2	0.014	0.51	6475	59	2	0.014	0.24	2316	281	2	0.014	0.29	4158	158	2	0.014	0.28	4045	202
3	0.014	0.49	6903	81	3	0.014	0.31	3013	176	3	0.014	0.33	4665	90	3	0.014	0.32	4588	183
4	0.014	0.53	5800	54	4	0.014	0.27	3428	202	4	0.014	0.30	4888	102	4	0.014	0.54	5152	215
5	0.014	0.63	6959	141	5	0.014	0.28	2373	191	5	0.014	0.30	3882	154	5	0.014	0.49	6589	193
6	0.014	0.57	6957	110	6	0.014	0.28	3601	171	6	0.014	0.30	2844	151	6	0.012	0.38	5110	260
7	0.012	0.65	7011	104	7	0.014	0.27	2588	189	7	0.014	0.28	3160	123	7	0.012	0.57	4764	203
8	0.012	0.51	4847	127	8	0.014	0.42	4054	133	8	0.014	0.32	3134	159	8	0.012	0.38	2615	259
9	0.012	0.49	3335	116	9	0.014	0.41	2845	139	9	0.014	0.36	3512	132	9	0.012	0.33	2707	247
10	0.012	0.44	2469	136	10	0.014	0.54	3821	132	10	0.014	0.40	3439	159	10	0.012	0.33	3374	271
11	0.012	0.37	4620	93	11	0.012	0.38	2712	113	11	0.012	0.43	3914	152	11	0.012	0.28	2046	284
12	0.012	0.35	2588	82	12	0.012	0.33	827	114	12	0.012	0.30	2896	184	12	0.012	0.32	1813	216
13	0.012	0.32	1605	181	13	0.012	0.31	2110	183	13	0.012	0.39	1409	182	13	0.012	..	..	..
14	0.012	0.33	1851	135	14	0.012	0.29	2026	181	14	0.012	0.31	1116	208	14	0.012	0.15	44	580
15	0.012	0.34	2315	117	15	0.012	0.22	1273	142	15	0.012	0.31	1765	200	15	0.012	0.09	27	420
16	0.012	0.32	1813	140	16	0.012	0.38	1893	118	16	0.012	0.34	1621	228	16	0.012	0.45	1198	360
17	0.012	0.34	1512	139	17	0.012	0.24	781	182	17	0.012	..	..	..	17	0.012	0.09	629	520
18	0.012	0.34	1294	165	18	0.012	0.29	1318	176	18	0.012	..	..	..	18	0.012	0.10	700	553
19	0.012	0.31	1559	249	19	0.018	0.36	3475	183	19	0.012	..	..	..	19	0.018	0.10	1257	1295
20	0.012	0.22	1238	230	20	0.040	0.26	4455	540	20	0.040	0.17	2837	585	20	0.018	0.09	147	1820
21	0.012	0.26	1471	200						21	0.040	0.10	504	815					
22	0.012	0.23	360	264															
23	0.018–0.040	0.10	960	876						No flow over screen no. 5 (Murray)									
24	0.018	0.06	58	755															

Total gallon flow 24 hr. = 9,368,953. Total pounds oven-dry pulp 24 hr. = 267,113 lb. (133.557 tons).

over their screens. You will note "Laminar" and "Turbulent" at the heads of the columns on the chart. These capacities are exceeded today on 14-plate units arranged in parallel with the proper feed controls and outlets.

An interesting side light on the shive count shown—the plant manager used this in analyzing customer complaints on quality and strength of pulp. With these factors, in connection with his cooking records, he had certain over-all shive count records set up for his standards which he used to govern the customer's complaints on quality. You will note the many variables. Each dam controlled the capacity of a two-plate diaphragm chamber. The screens were standard flat screens with various lengths to the toe blocks on all but the no. 1 screen which was a roller shoe. The over-all length of the stroke remained fairly constant. There were some out of level diaphragms, some internal diaphragm chamber leakage and considerable leakage around the ends of and edges of the plates.

On the latest screens the screen plates are mounted on neoprene gaskets with no side sealing strips on the top ends of the plates. This makes for a wider stream of pulp in motion over the plates, permitting the pulp which settles out on the edges of the flow to settle out on the unslotted ends of the plates, therefore leaving more exposed slotted area to pass accepted pulp.

In the Magnus Fabricated Screen Plate Installation and Instruction Bulletin you will find several of the new and approved methods of holding down screen plates which permit the use of $^1/_8$-in. thick neoprene gaskets—positive insurance against shive, dirt, and blow back pressure leakage.

When many mills charted the efficiency of their screens, it was found that regardless of the screen length there was always an area somewhere in the line, where certain plates screened the most and cleanest pulp.

Once most of these facts were known, the writer together with those men most interested, started to figure out how to duplicate these flow conditions of the pulp to the plates and over a near correctly planned screen length. The writer, having run a number of paper machines making many grades of paper at speeds from 20 to 500 f.p.m., had first hand experience in creating a flow of near even depth and width, with an accelerated flow velocity on the two outside edges; the flow on these two edges still not flowing faster than the center of the stream.

The velocity of the flow on the edges of this stream of pulp must be fairly close to the center velocity to keep settling out of pulp on the edges of the stream at a minimum.

Capacity charts shown in Table III are composites of 12-plate unit capacity and quality evaluation.

Many screen rooms were remodeled to take 28-plate lines—some built to utilize the 24-plate length. Floor space had to be considered; then finally bleached pulps had to be made cleaner to meet foreign competition. Then it was found that 16 plates should be the maximum plate length for a screen running bleached pulp.

Screen builders then ran into torque troubles on the drive and in the case of replacing the wood top, it became increasingly expensive and difficult to find clear cypress planks of suitable dimensions to make the sides of a 16-plate screen vat. Hence the popularity of 12 and 14-plate cast bronze and wood vats.

A close study of the data in Table II will reveal that there are sharp contrasts bordering the 14th and 15th plate position and the 24th and 28th plate positions.

Fiber particle size, as in the case of bleached fiber when fiber is released from the fiber bundles, semichemical, soda pulp, deinked, defibered old papers, and broken fiber, because

Table III.

	Capacity scale—per unit: Number of plates	Slot sizes	Pounds per unit	Average pounds per plate	Shives per gram per plate
		Laminar Flow			
1st	12	0.014	42,048	3500	42.56
2nd	12	0.012	24,870	2070	54.8
3rd	12	0.012	10,390	864	73.08
4th	8	0.012	4,628	587.5	118.87
		Combined 12-24-36 and 44 plate averages			
1st	12	0.014	42,048	3500	42.56
2nd	12–24	0.012	66,918	2786	48.78
3rd	12–36	0.012	77,308	2146	56.83
4th	8–44	0.012	81,936	1862	67.93
		Turbulent Flow			
1st	12	0.014	17,572	1464	115.9
2nd	8	0.014			
	4	0.012	16,847	1404	68.3
3rd	12	0.012	9,401	783	81.8
		Combined 12–24 and 36 plate averages			
1st	12	0.014	17,572	1464	115.9
2nd	12–24	0.014(8) 0.012(4)	34,418	1434	91.8
3rd	12–26	0.012	43,820	1211	88.69

of their smaller and shorter dimension, governs the length of the screen line. They will not stay in suspension in water in motion for distances exceeding 10 (10 ft.), 12, or 14 plates; hence shorter lines or shorter screens make for the most economical screen investments.

A 12 and 14-plate screen can be operated as six 2-plate or seven 2-plate units by using movable partitions in the screened pulp collector flume.

Some important facts to keep in mind are these: fiber has two dimensions, mainly length and diameter; the greater the length the greater the area subjected to the flow forces in the stream of water used to keep the fiber in suspension within the velocity limits of the flow. Hence one always finds the longest and strongest fiber in the run-off position and among the tailings.

Speck material, especially that type of wood dirt liberated from around the ingrown knots by the chipper and cooking process, has three very definite dimensions, i.e., length, width, and thickness. Because the thickness is invariably thinner than the width of the finest possible machine-made slot in any screen plate, the hydraulically created laminar flow does a remarkably good job at keeping these flat-shaped wood particles floating in a flat position over the slotted area of the plates.

Because all floating objects have a heavy end, and the heavy end has a tendency to be on the down-stream end of this objectionable speck particle, and because the volume of the water is a diminishing volume with a diminishing velocity, the distance that floating flat wood specks can be kept in suspension is limited. This, too, governs screen length.

Should the flow break from the laminar to the turbulent pattern, a rolling, tumbling motion is imparted to these particles and many are caught edgewise and drawn through the slots into the accepted pulp. Therefore a short line (14 plates) is the most efficient unit for many good reasons. See the article on "Selective Particle Separation. . ." Also, the article, "Controlled Hydraulics on Flat Screens," which should have been titled "Flow Forces through Adjoining Orifices" (see *Tech. Assn. Papers* 27: 375 (1944).

On the discovery of the efficiency of the 60 sq. in. outlet and the 5-in. wide priming seal without changing the slot size, the slot spacing (increasing the number of slots per inch), the amplitude of the stroke or increasing the number of strokes of the Pitman per minute, capacity wise, the plates in use at that time had a capacity of 800 lb. per plate per 24 hr. when run with a high dam (2 in. below plate level.) When dropped to less than diaphragm level the capacity of these same plates went to 3100 lb. per plate per 24 hr.

Then we had to search for the reason which is best shown in the diagram of the flow pattern over the slots, which extends from the center of the bar between the slots to the center of the next bar (see Fig. 3, "Controlled Hydraulics.")

The width of the bars between the slots then were found to be a large influencing factor in creating the flow field in the pulp over the slotted area of the plates giving this greater capacity.

Later on, we further reduced the number of slots per inch from 6 to 5, increasing the width of the bar between the slots. This did not radically increase the capacity but maintained a more uniform flow of pulp through the slots using less water and requiring less hosing of the plates.

Now refer to the M. Lowell Edwards article "A Study of Flat Screen Dynamics." There are some important facts shown in this article which still hold, i.e., the pressure per square inch on both the top of the plate and the under side. These pressure charts still hold true when the dams are too high or the diaphragm chamber is full of water which is backed up under the plates when the pipes or flumes are inadequate to keep screened pulp constantly flowing from the screens to the thickeners.

The screens used in this Weyerhaeuser test have one diaphragm chamber for 12 plates—no drop leg for a priming seal—the diaphragm chamber is 11 in. deep. Therefore, these screens had to be operated with a water blow-back and each unit set level, with a drop between each section. This arrangement is now obsolete. The only screens possible to operate with an air blow back have positive sealed off compartments, including the diaphragm chamber under two plates, with a continuing partition separating the priming seals from each pair of plates.

Many screens are built with one dam to control the height of the water seal between 4, 6, 8, 10, or 12 plates, therefore the dams must be set high, because the lift of the cams which lift the diaphragms have the lifting order in the same sequence as the firing order on six-cylinder gasoline engines.

Part of the pressure on the up stroke of a diaphragm is pushed through the slots and part pushed through the diaphragm chamber outlets into the adjoining diaphragm outlet —hence the high water level necessary to be maintained to get a cleaning action through the slots. This is the direct cause for pulp to attach itself to the under sides of the plates and make pulp forming strings of pulp (see Fig. 12 in the M. Lowell Edwards' article).

With one dam for each two-plate diaphragm chamber, the water need not be pushed back and forth through the slots, there being no back wash of flow through the under side of the plate, hence no pulp forming strings are developed—a very desirable feature obtained only on the newer type of flat screens, and a very obnoxious feature on the old flat screens and rather pronounced on some of the new type of pressure screens.

Because gage pressures are generated by a positive water blow-back amounting to approximately 2 (plus) p.s.i. on the under side of the plates, this becomes a very damaging water hammer at 600 strokes per min., 846,000 strokes per diaphragm chamber per 24 hr.

This gage pressure disappears when the screens have been built with the 60 to 64 sq. in. outlet and 5-in. wide priming seal. It then becomes a fluttering atmospheric pressure which produces that very efficient flow pattern shown in Fig. 3 in the article "Controlled Hydraulics."

The Fig. 4 ("Controlled Hydraulics") shows the very limited flow field over the top of the plates when a water blow-back is used.

Some of the illustrations shown in the article "A Study of Flat Screen Dynamics" show how the pulp is matted, formed, and piled up, stapled or "hair-pinned" on the bars between the plates, an action which requires heavy and frequent hosings and almost continuous use of shower pipes, either oscillating or swinging.

Every time a flat laminar stream of pulp is hit with a stream of water from either a hose or shower pipe the water gradient is bent, the flow turned over and converted to a turbulent area which carries the dirt through the slots. This was revealed many times in those mills using the analysis chart, Table I.

Immediately under the dilution water pipe and for several plates beyond it on the downstream side no pulp should be accepted from a screen, or when it is being hosed. A standby spare screen should always be clean and ready to go into service as soon as an operator thinks a screen should be hosed. A quick shift of the flow control gate valves will do it without any loss of time to adjust the volume if you have installed metering gates in your headboxes. This takes care of about 1 week's accumulation of dirt particles.

Pressure headers while concealing the pipes used to carry the pulp to the heads of the screens, are prone to become plugged with thickened pulp which may require a complete shut-down of the pulp pumping equipment, while an elbow or valve is removed and the thickened pulp removed.

A gravity-fed unit unplugs itself or can be unplugged with

a hose let down into the opening of the pipe if the pulp does become thickened to the point where it will not flow.

Flexibility of the control of each unit for shut-downs or cutbacks in production has been carefully engineered. You can use power only on those screens you require for the tonnage you wish to screen at that time.

It is destructive to your equipment to have the power on a unit not loaded with pulp and it is equally destructive to this equipment if a limited tonnage is spread to excess over too many screens. This is usually done by operating with the dams set too high, which builds up the run-off but concentrates those damaging blow-back pressures in each diaphragm chamber, damaging to both plates, diaphragms, and drives.

Very important, also, is the sloping or pitching of the pipes from the collector troughs to the headers delivering pulp to the thickeners, also the slope or pitch of the pipes at the run-off end of the screens into a common header leading the pulp to some rescreen or centrifugal speck removing equipment.

By correctly sloping these pipes, vortexing in the pipes will be greatly reduced and the capacity of these pipes will be accordingly greater (Fig. 2).

This volume of information, incidentally, is really composed of the findings of many pulp mill men who have given to the author the benefit of their experiences and the author has, in turn, set these experiences into their proper helpful sequence. All men and all facts listed are concerned with the fitting of over 40,000 stainless steel screen plates to the business of producing cleaner pulp and reducing repair and maintenance costs.

RECENT BOOKS

Bibliography of Papermaking and United States Patents—1953. Complied by W. B. Weber and Jack Weiner, Institute of Paper Chemistry. TAPPI, New York, 1954. Cloth, 6 × 9, 520 pages. $7.00.

The annual bibliography is issued by the Technical Association of the Pulp and Paper Industry covering all articles published in journals and books throughout the world relating to pulp and paper manufacture and use. A listing with brief abstracts of the United States patents on papermaking is included. This is the first bibliography prepared by compilers other than Clarence J. West. The 1954 Bibliography is scheduled to be issued during the current year.

Sonics. By Theodor F. Hueter and Richard H. Bolt, Massachusetts Institute of Technology. John Wiley & Sons, New York, 1955. Cloth, 6 × 9, 456 pages. $10.

The authors are professors of physics and accoustics at M.I.T. Their book deals with the techniques for the use of sound and ultrasound in engineering and science. The four major points covered are: fundamental physics of vibration and sound, design principles of electroacoustic and fluid-dynamic transducers, choice of sonic variables for systems engineering, and special techniques for testing and processing. This information is cast within the framework of basic physics so that the common features of seemingly unrelated techniques and devices become apparent.

In spanning the entire frequency range, the authors are concerned primarily with industrial applications and, therefore, give precedence to questions of technique and instrumentation. The applications are divided into sonic processing and sonic analysis, with typical examples selected to illustrate operating principles. Wherever possible, a discussion concludes with simplified engineering formulas and practical instructions for their application. Similarly, the results of equations are frequently condensed into tables and design curves for immediate engineering use.

Handbuch English-American Paper Format. By Wilhelm Mohrberg and Manfred Knopp. Edward Roether, Darmstadt, Germany. Paper cover, 6 × 8 1/4, 100 pages. 12 DM.

A useful handbook prepared in the form of tables and graphs showing sizes of American and British reams and curves from which most sizes and weights of paper may be converted. The book should be of value particularly to merchants and paper converters.

Chemical Process Principles, 2nd Ed. Part I, Material and Energy Balances. By Olaf A. Hougan and Roland A. Ragatz, University of Wisconsin, and Kenneth M. Watson, Pure Oil Co. John Wiley & Sons, New York. 6 × 9, 520 pages. $8.50.

The first book in a three-volume set bringing up to date the texts first published in 1943. The other two volumes to be issued will cover thermodynamics and kinetics and catalysis. The first volume concentrates on process problems of a chemical and physico-chemical nature, and avoids overlapping into the fields of unit operations and equipment design. It deals primarily with the applications of physical chemistry, thermophysics, thermochemistry, and the first law of thermodynamics. Utilizing recent developments in thermodynamics, the authors integrate generalized principles into procedures for process design and analysis which are aimed at getting the best possible results from a minimum of pilot-plant or test data.

Among the subjects covered are stoichimetive and composition relations, behavior of gases, vapor pressing humidity and saturation, material balances, adsorption, fuels and combustion, thermophysics and thermochemistry.

Pappe als Werkstoff Band 4. By Fritz Hoyer, Kothen. Sandig Verlag Wiesbaden, Germany, 1954. Paper cover, 5 3/4 × 8 1/4, 164 pages. 8.5 DM.

A review of the general processes of making paper. The principal section is devoted to the various uses of special papers. Other chapters deal with paper defects, paper furnish, and common tests.

Note: Books reviewed in this column may be obtained from the Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

EMPLOYMENT SERVICE

Positions Wanted

E295-55. Chemical Engineer experienced in formulation and application of clay-type, resinous, emulsion, and wax coatings in the lab and in production; also laminating operations, laboratory supervision, food wrapper technology, some printing and sulphite paper production. Able to obtain cooperation and results; 20 years' experience. Prefer supervision of coating operations, their development, or laboratory supervision.

E296-55. Superintendent. Graduate chemical engineer, age 40, with 15 years' experience in pulp and paper as superintendent of operations and technical control. Experienced labor relations. Desires change. Presently employed. Excellent references.

MILL MANAGER for a new 100 ton newsprint mill

PROJECT MANAGER to supervise development of a 100 ton dissolving pulp mill

Also Project Engineers

QUALIFICATIONS:

Appropriate engineering & operating experience & background. Spanish speaking ability desirable but not essential

Reply in confidence with complete résumé to *Tappi*, p440-55, 155 East 44th St., New York 17, N. Y.

E300-55. European Representative. Graduate mechanical engineer. 40. Desires appointment as European or Scandinavian representative of pulp and paper equipment manufacturer or as technical contact man for sales organization. Wide experience in manufacture, introducing new equipment, and licensing manufacturers in various countries. Thoroughly acquainted with market possibilities through extensive travel in Europe and with American equipment as result of tours through U.S.A. and Canada. Speaks English and German fluently. U. S. and Swedish references.

E301-55. Chemical Engineer; 34, married; 9 years' pulp and paper experience in supervisory, development, and control work. Acid and alkaline pulping, book and bond paper. Desire position with opportunity and challenge in supervisory or development work with a progressive company.

E302-55. Organic chemist, Ph.D., with seven-year background, mostly in the chemical industry, but with some experience in the paper field, desires research position in the paper industry, possibly in a company with chemical interest. Administrative experience. Background in application and process work. North central or eastern location preferred.

Positions Open

P424-55. Experienced Graduate from technical university is wanted for planning and control work at paper mill with sulphite and groundwood mill in Norway. Experience from fast running paper machines and working knowledge of any of the Scandinavian languages most desirable. Age 35–45 years. Application to be sent Managing Director, A/S Follum Fabrikker, Honefoss, Norway.

P436-55. Instructor in Paper Engineering Department at Lowell Technological Institute, Lowell, Mass., to lecture in pulp and paper manufacture and to teach associated laboratory work. Experience and training, more than age, is most important consideration. Write to Prof. John Lewis.

P437-55. Major Boxboard Producer and Converter needs technically trained man. Must have at least two years' experience in board mill operation or in coating of board or paper. Experience in machine or off machine coating acceptable.

P438-55. Chemist, age 26 to 40, with a B.S. degree in Chemistry or Chemical Engineering, who has had 2 to 5 years' experience in paper manufacturing, for development and control work in medium-sized, progressive paper mill located in the Miami Valley. Good opportunity, many desirable fringe benefits, excellent working conditions. Good starting salary. Send résumé, with photograph, and salary requirements.

P439-55. Chemical Engineer. To work in technical department of new and expanding bleached pulp mill in Southeastern North Carolina. Must have from 3 to 6 years' experience in pulp manufacture. Salary commensurate with qualifications. Please make résumé as complete as possible and submit recent photograph. Riegel Carolina Corp., Acme, N. C.

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WORTHEN BRAUN MEMORIAL COMPETITION

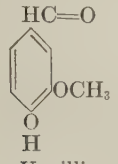
Edmundston, , N. B., Sept. 11, 1954

The Detection of Lignin

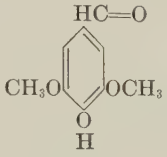
WILLIAM H. HOGE

Occasionally there is need for a test to determine if a sample contains lignin. Sometimes, particularly in the study of certain process residues, it can be very helpful to know if the lignin is hardwood or softwood in origin. The color reactions often are unsuitable and in most cases they do not give specific tests for lignin.

One of the most specific tests for lignin is the formation of certain aromatic aldehydes upon oxidation. Softwood (gymnosperm) lignin forms vanillin and the hardwood (angiosperm) lignin forms a mixture which contains about 3 parts syringaldehyde to 1 part vanillin. The formation of these aldehydes has been used as the basis for a quantitative



Vanillin



Syringaldehyde

determination of softwood and hardwood lignin by Stone and Blundell (*1*). Their procedure involves the quantitative oxidation of a lignin sample with alkaline nitrobenzene, the separation of vanillin and syringaldehyde on a paper chromatogram, extraction of the aldehydes from the paper, and their quantitative determination by ultraviolet absorption measurements. The extraction of the aldehydes and the spectrophotometric determination may be omitted if qualitative results are satisfactory.

The nitrobenzene oxidation of lignin is conducted in a small bomb for $2^1/_2$ hr. at 160°C. This step is quite tedious and, therefore, a search was made for a simplified oxidation technique that would be satisfactory for qualitative results. The atmospheric pressure oxidation of lignin products by Fehling's solution had been reported by Pearl (*2*) who obtained vanillin yields of 9 to 16%. The substitution of Fehling's solution for the nitrobenzene led to the development of an easy, rapid variation of the Stone-Blundell technique which is satisfactory for the qualitative detection of hardwood and softwood lignin.

PROCEDURE

A small portion of sample, containing 50 to 200 mg. of lignin, is treated with 20 ml. each of Fehling's solutions A and B (*3*) in a tall form, 250-ml. beaker. Boiling chips are added to prevent bumping, and the mixture is allowed to simmer on a hot plate for about an hour. Additional water may be added if necessary. The solution is cooled and treated with the dropwise addition of concentrated hydrochloric acid until it is strongly acid to indicator paper. The acid mixture is extracted several times with ethyl ether. The extractions are conveniently conducted in the tall form beaker by adding about 40 ml. of ether, mildly stirring for several minutes, and decanting off the ether phase. Strong agitation during the extraction stage tends to promote the formation of troublesome emulsions. The combined ether extract is evaporated to dryness in a warm water bath with care to avoid excessive heating of the residue. The residue is leached with several milliliters of ether to obtain the solution for chromatographic analysis. The intermediate drying allows the elimination of certain interfering materials which are not redissolved in the ether.

The chromatographic separation of vanillin and syringaldehyde was accomplished with the use of water-saturated *n*-butyl ether, proposed by Stone and Blundell (*1*). Practically all of the chromatograms were made on Whatman no. 1 filter paper in closed chromatographic jars with descending developer. However, if this equipment is not available, satisfactory results can be obtained in a large wide-mouthed, screw-capped jar. One end of the paper strip is taped to the inner jar lid and the other end is allowed to hang in the developing solvent. Chromatograms with ascending developer were comparable to those obtained with the standard descending procedure.

The aldehydes are transferred to the filter paper by spotting a portion of the ether solution on the starting line, which is situated several inches from the end of the paper immersed in the solvent tank. The paper strips are then conditioned for 30 min. or more in the water-saturated atmosphere of the closed chromatographic jar. The developing solvent is added and the chromatogram is allowed to develop for $1^1/_2$ to 3 hr. The paper is then removed from the jar and allowed to dry.

The dried chromatogram is sprayed with a reagent which forms colored compounds with the aldehydes. The spray reagent was a freshly prepared mixture of 1% solutions of ferric chloride and potassium ferricyanide, as proposed by Barton, Evans, and Gardner (*4*). This mixture forms a dark blue color with phenols and certain other types of compounds. The freshly sprayed chromatogram is successively washed in dilute hydrochloric acid and water to prevent the background from darkening.

The vanillin and the syringaldehyde are identified by their positions on the chromatogram. Vanillin occurs at an R_f* value of 0.65 to 0.7 and syringaldehyde is found at R_f of 0.4. A photograph of a typical chromatogram is shown in Fig. 1. The hardwood lignin formed a mixture of vanillin and syringaldehyde whereas the softwood sample formed vanillin alone. The material remaining on the starting line is presumably a mixture of lignin degradation products and has no significance in the analysis.

DISCUSSION OF THE METHOD

The described method of oxidation with Fehling's solution gives relatively low yields of vanillin. A group of oxidations were conducted on samples of sulphite spent liquor and kraft black liquor from softwoods. The yield of vanillin in the combined ether extract, in most cases, was 2 to 3%, based on the lignin. In contrast, the reported yields from nitrobenzene oxidations are 27 to 28 %. The yield of vanillin was determined by dissolving it in ethanol containing a small amount of potassium hydroxide and calculating the con-

William H. Hoge, Research Department, Oxford Paper Co., Rumford, Me.

* The R_f value of a compound is the ratio between the distance moved by that compound and the distance moved by the solvent front.

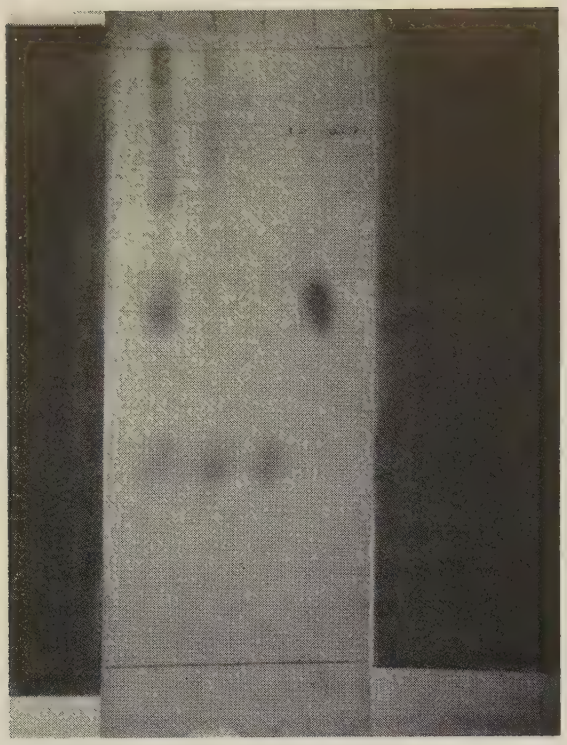


Fig. 1. Chromatogram developed with butyl ether; compounds (1. to r.) are hardwood lignin, softwood lignin, vanillin, and syringaldehyde

centration from the absorbance at 353 mmu, as proposed by Lemon (*5*). The low vanillin yield restricts the Fehling's solution oxidation to qualitative applications.

The chromatographic separation of vanillin and syringaldehyde can also be accomplished by developing solvents other than butyl ether. Water-saturated petroleum ether (high boiling fraction), as proposed by Bland (*6*), gives a satisfactory separation in 3 to 4 hr. The approximate R_f values for the syringaldehyde and vanillin are 0.06 and 0.15, respectively A developing solvent of butanol saturated with 2% aqueous ammonia was used by Jayne (*7*) for vanillin and its chlorinated derivatives. Vanillin has an R_f of about 0.4 and syringaldehyde is found at 0.3 The separation of vanillin and syringaldehyde by this solvent requires 16 to 20 hr. The butanol-ammonia developer must be used in a dry atmosphere; the butyl ether and petroleum ether require the preconditioning of the undeveloped chromatogram in a water-saturated atmosphere.

The procedure, as outlined, has been tested with several different types of lignin. Satisfactory results have been obtained with sulphite spent liquors, kraft black liquors, lignin in white water from a groundwood mill, and uncooked wood shavings. The procedure has not been satisfactory for identification of oxidized lignins from pulp bleaching operations.

SUMMARY

One of the most specific tests for lignin is the formation of vanillin upon oxidation. The oxidation with Fehling's solution and the resolution of the products on a paper chromatogram forms a convenient method to establish the presence of lignin and to determine if the lignin originated in hardwoods or softwoods.

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Latex Retention

ALBERT J. MARCHAND

Adding resin to beaten fibers is not a new subject. Many mills are producing resin-containing sheets on a full-scale basis using the beater addition technique.

The theory of resin addition in the beater is closely paralleled to beater sizing. Since more rubber or latex resins are alkaline, a suitable acid solution is needed to coagulate the resin on the fiber, since the water suspension of the fibers is almost always in the neutral range.

In rosin sizing the resinate radical has a low minus valence, and since opposite charges attract to give coagulation, a positive ion is required; preferably one of a high plus valence. For this reason, alum, whose aluminum ion has a plus valence of 3, is used to coagulate rosin to aluminum resinate.

Oliner and O'Neil (*1*) found that by adding a solution of alum to the beater with a polyvinyl chloride resin, they could coagulate the resin on the fibers. They do not discuss the order of addition. However, Yost and Aiken's (*2*) theory that the addition of latex to the pulp after beating, followed by coagulation with alum gave the best results was accepted and introduced into the procedure. Oliner and O'Neil obtained no retention values for plasticized polyvinyl chloride, but kid obtain a 54.1% retention for unplasticized polyvinyl chloride. They determined retention by extraction. Yost and Aiken concluded an optimum pH between 4.5 and 5.5 based on physical properties and retention.

PROCEDURE

Unbleached kraft pulp was slushed up in a Lightnin mixer until the pulp was completely defibered. The stock was then beaten at a consistency of 1.5% in a TAPPI Standard beater for approximately 1 hr. to a Canadian freeness of 375 ml. with a load of 5500 grams on the bedplate.

Using the Noble & Wood handsheet machine technique, adjust consistency regulator to produce nine sheets of 2.5 grams. Extract one sample sheet to check weight.

Under the following conditions, make sets of handsheets recirculating white water. Record sequence of sheets as made.

1. To the consistency regulator, add 20% (total solids) by weight (based on the moisture-free fiber) of plasticized polyvinyl chloride. Determine total solids from the data supplied by the manufacturer of the resin. Mix well for 10 min., then add a 4 to 8% solution of alum to regulate pH (Leeds-Northrop pH meter) as follows: run 1—pH of 4.3, run 2—pH of 5.0, run 3—pH as low as possible (about 3.5).
2. Repeat (1), omitting the use of alum, which will give a pH of about 6.0.
3. Make a blank sheet run by omitting the use of polyvinyl chloride and alum.

Press handsheets under standard conditions between blotter stock or clean felt. Dry sheets at medium temperature between blotter stock on hot plate.

Place all sheets in a 50% R.H., 70°F. conditioning room for at least 24 hr.; record sheet weight accurately on an analytical balance. Determine the moisture content of each set of sheets.

Repeat entire procedure to check results.

DISCUSSION

Since complete coagulation of resin with alum is probably never attained, most of the unaltered resin will go through the wire with the white water. By recirculating the white water, this unaltered resin may be used to increase the retention of the succeeding sheets. Furthermore, in varying acid mediums, the alkaline resin may coagulate with varying completeness.

Albert J. Marchand, Fraser Paper, Ltd., Madawaska, Me.

Table I. "Fine" Fiber Pickup Using White Water Recirculation

Sheet no. as made	*Average % "fine" pickup*
1	0
2	0.442
3	0.95
4	1.15
5	1.3
6	1.45
7	1.6

Since resin and fiber have different affinities for water, sheets of varying resin contents may have varying moisture contents at a set humidity and temperature.

Fine fiber pickup: The fiber pickup due to white water recirculation was determined on the blank waterleaf sheets. The results are given in Table I. The curve appears to be leveling off at approximately 2%, but it does not show complete leveling off because seven sheets does not seem sufficient to bring the white water to equilibrium. A 2% "fine" fiber pickup does not produce an appreciable effect on retention, but for purposes of calculation, is considered.

Resin Retention: Table II show the effect of white water recirculation on retention. In each case of final pH, the tendency is toward increased retention with the employment of white water recirculation. Varying degrees of coagulation appear with the initial sheet, which lacks white water recirculation; but as the uncoagulated resin is re-used with the white water, increased retentions are obtained.

Moisture content of resin-loaded sheets: The moisture determinations show that the sheets containing the most resin as measured by retention have a lower moisture content then both the waterleaf sheets and those sheets with less resin content. This indicates that the fiber has a greater affinity for water than has the resin. Consequently, this leads the author to believe that a sheet, well saturated with polyvinyl chloride, will have poor moisture regain.

Resin Retention: The data in Table III show a more complete coagulation with low values of pH. For high values of final pH (5.0 to 6.0), the curve levels off very slowly, indicating small increases in coagulation with progressive sheets. The curves for low pH (4.5 to 3.4) reach a maximum very quickly, indicating that highest degree of coagulating is obtained more rapidly in a very acid medium.

Effect of pH on Retention: It is apparent from the data that a low pH is desirable. A retention in the range of 20 to 30% is obtained for a pH range of 5.0 to 6.0. When the pH is lower to 4.3 a retention of approximately 40% is obtainted. This is the range termed "optimum" by A. W. Oliner and F. W. O'Neil.

However, even with the absence of white water recirculation, a higher retention value than has previously been recorded (64.1%)* was attained by lowering the pH to 3.4. Furthermore, by recirculating white water, a retention value of 92% was obtained. The results show that completeness of coagulation varies with acidity, and consequently, retention also will vary with acidity.

* This retention value was recorded for unplasticized polyvinyl chloride. The plasticizer in the polyvinyl chloride used may have had some effect on retention.

Table II. Moisture Regain at Varying pH Values

Final beater pH	*Moisture content at 50% R.H., 70°F., %*
3.4 (Run 3)	5.15
4.3 (Run 1)	5.47
5.0 (Run 2)	6.30
6.0 (Run 4)	6.60
Blank sheets (Run 5)[a]	6.11

[a] The final pH of the blank sheets was between 5.0 and 6.0.

Table III. Average Per Cent Retention at Different Final pH Values with White Water Recirculation

Sheet no. as made	*Final pH 3.4*	*Final pH 4.3*	*Final pH 5.0*	*Final pH 6.0*
1	71	38	25	26
2	88	42.8	45	36.5
3	90	37	45	36.5
4	91.2	54	48.8	36.5
5	96.5	46	51.7	48
6	93.8	46.5	49.7	40.5
7	92.6	43.2	46	43

CONCLUSION

The following conclusions are based on the data obtained during this experiment.

1. A pH value in the range of 3.5 is recommended for the highest retention.
2. Retention is increased with white water recirculation, more so in the low pH range.
3. A final pH of 3.4 gives the best retention with and without white water recirculation.

RECOMMENDATION

The results of this experiment yield several recommendations.

1. It is recommended that an investigation be conducted to determine physical properties of sheets with the final pH values used in this project. These results should be compared to results from impregnated samples to determine which method is more desirable. An optimum pH in the beater addition technique can also be determined.

2. To study retention further, pH values below 3.4 should be investigated. This will be impossible with alum alone as the coagulating agent, but sulphuric acid in small portions will also lower the pH. Again a study of physical properties should be made since no optimum pH value can be reasonably selected without the knowledge of its effect on physical strength.

3. Resin content is another variable which deserves consideration. In this experiment, 20% total resin was added to the stock. However, it is likely that more resin could be added with varying pH for practical applications.

4. Application of this and related experiments which may be conducted to actual mill conditions. Variables to be studied are stock consistency, wire appearance after sheet formation (some resins may clog up wire at certain pH values), and application of techniques to large scale production.

5. In this experiment, plasticized polyvinyl chloride was used. Unplasticized polyvinyl chloride as a beater additive, using the previously mentioned variables, would prove noteworthy of study. Retention by weight could be abolished in favor of the Soxhlet extraction method.

6. Other variables which also deserve consideration and are recommended for futher study are pulp (bleached and unbleached), curing, combining polyvinyl chloride with nitrile rubbers, and beating time. This latter variable is discussed briefly by Oliner and O'Neil. They concluded that resin retention increases with beating time to a point, and then levels off. An optimum beating time would be a desirable conclusion.

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The original work was part of a senior project at the Lowell Technological Institute, Lowell, Mass.

E. J. ALBERT AWARD PAPERS—1954

Delaware Valley Section, Philadelphia, Pa., May 27, 1954

Basis Weight Variations and Their Effect on Size-Press Coated Paper Properties

MILLARD M. MUNTZ

THIS paper is a report on an attempt to correlate the property variations of a calendered finished, size-press coated paper and the basis weight variations occurring during the manufacturing of the base stock.

The problem as it presented itself in the high finished coated paper is shown in Fig. 1. This graph represents a profile study of a size-press coated paper and the variations in the paper properties at the indicated positions across the web. All functions of the graph, with the exception of the basis weight, are expressed in per cent variation from the average value which is represented by the 0 line, and, therefore, are all in the same order of magnitude. The basis weight variation is expressed in per cent variation from the specified basis weight of 45 lb.

The basis weight, indicated by the solid line, varies from 44.4 to 47.9 lb., or an over-all range of 3.5 lb. This variation could be a result of the coating pickup; however, this cause was eliminated when the ash content (indicated by the broken line) of the sheet proved the coating weight to be uniformly distributed across the sheet. For example, position 1, the minimum weight, has a basis weight of 44.4 lb. and an ash content of 21.1%, or a coating pickup of 9.35 lb. In comparison, position 11 has the maximum basis weight of 47.9 lb. and an ash content of 19.5%, or a coating weight of 9.34 lb. These two positions have the same coating weight and at the same time vary greatly in their final paper properties.

The above comparison was a basis for starting a study of the base stock variations in basis weight. The fiber content of the sheet, as shown in the first line at the bottom of the graph, varies from 35.1 lb. in position 1 to 38.6 lb. for position 11, or a difference of 3.5 lb. This difference in fiber content is the same as the difference in the final basis weights for these two positions.

The wide range of variations in several of the finished paper properties occur at the same position where the fiber contents vary. Values demonstrating such variations are shown at the bottom of the graph.

For example, comparing position 1 and position 11, the smoothness varies from 114/61 to 400/222 sec. and the porosity ranges from 347 to 645 sec. The coating weights, as indicated before, are identical, but a difference occurs in the fiber content.

The property variations of the sheet may be explained by the action of the calender rolls, on the positions having a variation in fiber content, and therefore, a difference in caliper. The action of the calender rolls is more severe on positions having a high caliper resulting from difference of fiber content. The lower caliper (indicated by the circle line), the higher porosity and the higher opacity (indicated by the X line) in the areas having a greater fiber content, are an indication of the degree of calendering the position received. The opacity is only partly an indication of the degree of calendering since it is influenced by the basis weight and ash content. Calendering usually has the opposite effect on the opacity of the paper.

To determine basis weight variations occurring on the paper machine, the paper web was divided into individual tracks on $5^3/_4$-in. centers. Each sampled web consisted of a 10-sheet thickness of paper. As many tracks as possible were taken across the web. The series of tests discussed in this paper consists of 12 track samples.

To eliminate as much variation as possible in the track dimensions, all the $5^3/_4$-in. tracks were trimmed at the same time with four single cuts on a guillotine trimmer to a final dimension of 19 by 5 in.—grain long.

Thus, each individual track, consisting of 10 sheets of paper (each sheet being 19 by 5 in.), represented a 25 by 38-in. sheet of paper and was weighed on standard ream basis weight scales to give directly a 25 × 38—500 ream weight. The basis weights of all the grades of paper were converted to a 25× 38—500 basis for simplicity.

A bar graph (Fig. 2) was constructed first using these data showing variations in the cross-machine direction. In this graph, the basis weight of each individual track is represented as the abscissa and the position number of the track as the ordinate. All tracks were numbered from the front to the back of the machine.

The solid reference line represents the specified basis weight, and the dotted line represents the average basis weight as found.

The average basis weight of this sample is 30.5 lb. or 0.5 lb. off the specified basis weight; however, the weight profile of the sheet is widely varied. In this particular sample, a total range of 3.0 lb. occurred across the sheet.

It is readily seen from this profile that if a uniform coating pickup occurs at the size press on a nonuniform basis weight web such as this, the compacting action of the calender rolls may create a variety of variations in the properties of a finished coated paper.

A bar graph, showing the profile of the paper web, proved useful during the testing periods. It aided the machine tender to make such adjustments as were possible to make corrections at the wet end of the machine. In one particular instance, the

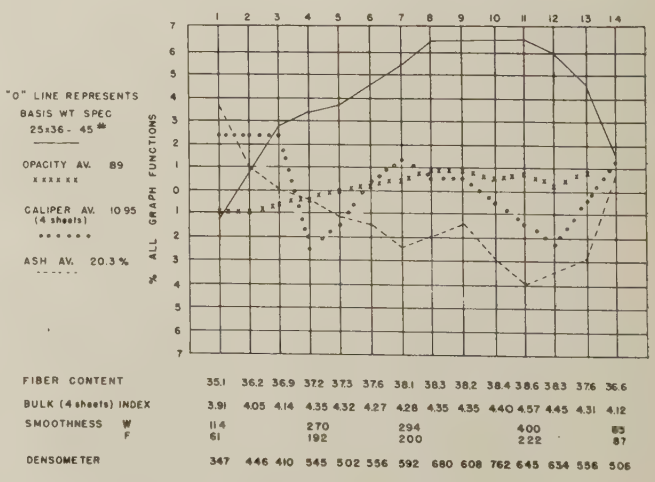

Fig. 1

MILLARD M. MUNTZ, Chemist, P. H. Glatfelter Co., Spring Grove, Pa.

machine tender was able to decrease the over-all variation from 2.8 to 0.7 lb. This method could be utilized as a routine control or as a check during a shift to give the machine tender an opportunity to make such adjustments as necessary to improve the sheet profile. Better profiles should result in better printing and coating surfaces and improved drying characteristics on the machine.

To check the results obtained by weighing each individual track on the basis weight scales, several checks were made by weighing each individual sheet of each track on a triple beam balance. A comparison of the basis weight values obtained by these two methods checked within 0.3 to 0.4 lb. per 25 × 38—500 basis.

By weighing each individual sheet, the basis weights in both machine directions were determined for relatively short distances or $5^3/_4$-in. centers for the cross and approximately 40 in. in the machine direction. These data not only served as a check on the individual track weights, but, also, served as a valuable tool for presenting the data statistically. Statistical studies were then made of the basis weight averages and ranges.

The control limits used were determined in accordance with American Standards Association Control Chart Method (*1*). The control charts are expressed in terms of sigma limits which are the standard deviations from the arithmetic mean or the grand average. When all points fall within the limits, it is shown that the process is in statistical control, and the machine is functioning as well as possible with the existing equipment. When points fall outside the limits, very strong evidence is presented that the process is not in control and is not functioning as it should due to the presence of some outside variable or variables.

The control limits used in the control charts are based on 3-sigma limits. Three-sigma limits were chosen over 2-sigma limits as an aid in finding indications of assignable causes for the variations that cannot be found with narrower control limits. The process should be 99.7% within statistical control for 3-sigma limits.

Control charts showing the variation occurring in both machine directions were constructed. Weight variations in the cross-machine direction were results of the average of 10

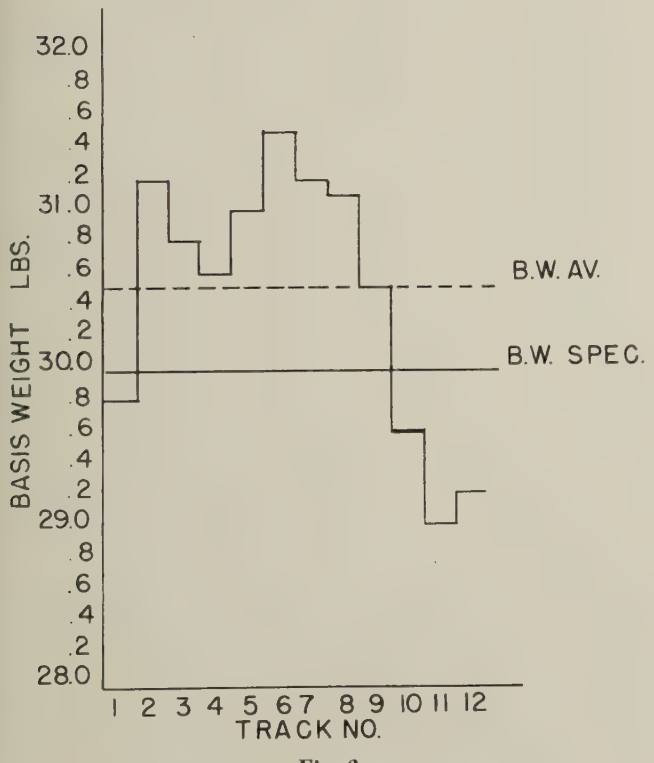

Fig. 2

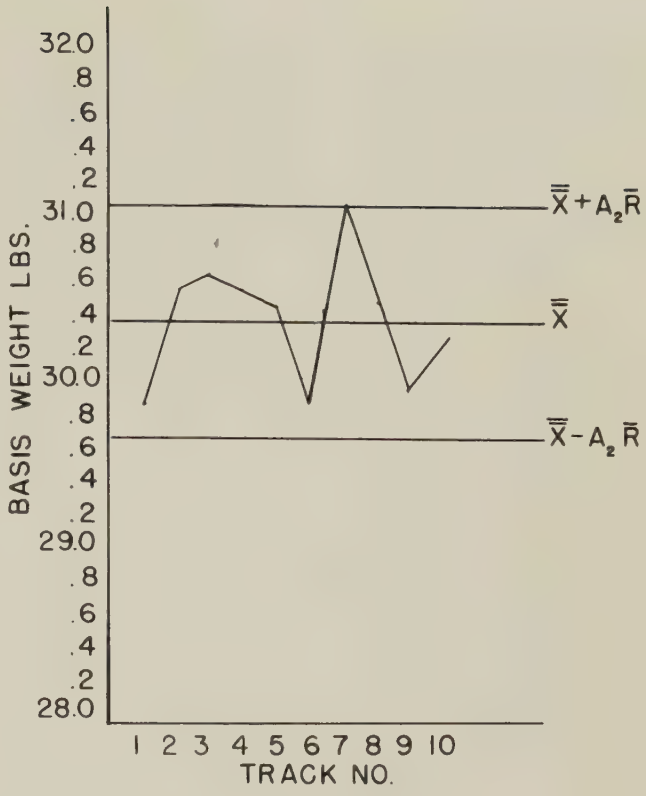

Fig. 3

observations in each of 12 subgroups. The machine direction weight variations graphed were the averages of 12 observations in 10 subgroups or tracks.

The range was determined by subtracting the smallest observation from the largest observation for each subgroup. The average ranges are the averages for the 10 and 12 subgroups, respectively.

Figure 3 is the statistical profile of the cross-machine basis weight variations shown as a bar graph in Fig. 2. The upper and lower control limits are represented by the formula $\bar{\bar{X}} \pm A_2\bar{R}$, where $\bar{\bar{X}}$ is the grand average basis weight, $\bar{R}$ the average range, and A_2, a conversion factor based on a normal distribution curve and determined by the number of observations in a subgroup.

In Fig. 3, tracks 2, 6, 7, 8, 10, 11, and 12 are out of statistical control for 3-sigma limits, and thus 58% of the $5^3/_4$-in. center tracks across the machine web were out of control. When the customary 5% normal trade allowance is considered, the paper is commercially acceptable. This fact should not be interpreted to mean that the variations are in order, but should place emphasis on the importance of maintaining the best possible control. Production may not be unduly concerned since the trade allowance is met, but statistically 7 tracks out of 12 are prohibitively wide for coating raw stock.

This pattern is typical of reel-to-reel sampling experience and was the basis for instituting an investigation of the stock flow onto the slice apron from the Bird screen discharge.

Figure 4 represents the machine direction variations of the same sample. This process was 100% within statistical control for 3-sigma limits.

Range control charts were constructed for the various samples and all the ranges for both machine directions fell within control limits. To quote E. L. Grant, "*R* as a measure of subgroup is always necessary to provide a basis for calculating limits on a control chart for $\bar{X}$ and to permit estimates of sigma prime. For many industrial quality characteristics, experience shows that *R* never goes out of control even though $\bar{X}$ does so frequently. In such cases the keeping of an *R* chart merely adds to cost without supplying any useful

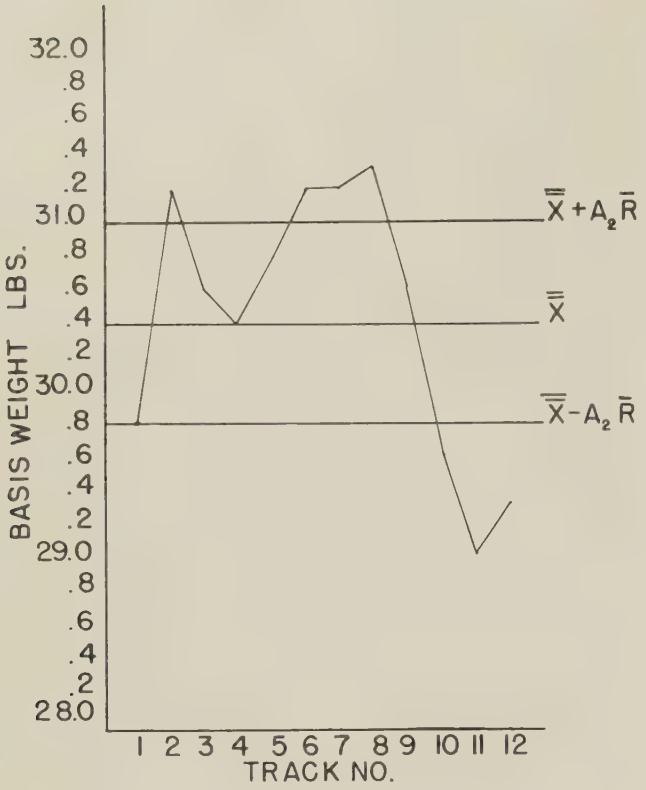

Fig. 4

information" (*2*). For this reason the range control charts were eliminated from this paper.

The results may be summed as follows:

1. To have uniform properties in a size-press coated paper with a uniform coating pickup, the base stock must be uniform.
2. The cross-machine direction was found to be out of control in most cases, while a wider over-all range occurred in the machine direction.
3. Bar graphs may be used for routine control as an aid to improve the sheet profile.
4. Further investigations of the variables causing basis weight variations are indicated.

LITERATURE CITED

1. American War Standards Z1.1-1941 and Z1.2-1941, "Guide for Quality Control and Control Chart Method for Analyzing Data," American Standards Association, N. Y., 1941.
2. Grant, E. L., "Statistical Quality Control," 1st ed., vol. I, page 117, New York, N. Y., McGraw-Hill Book Co., Inc., 1946.

Experience of a Paper Mill with Radioactive Fall-out

FRANK J. SLABY

THE ubiquitous atom has always played a prominent but somewhat obscure role in the life of man. During the last decade, however, it has progressed from the quiet of the laboratories to the most violent man-made explosion, the hydrogen bomb. In view of the latter, the atom has become rather ominous to the layman. The prospects of atomic energy for peacetime application, however, is one of the brighter aspects of the atomic age.

Of the outstanding facets of the atomic age, the proportions of its unprecedented growth have been the most spectacular. Its effects on our industrial, economic, and social welfare have been a foregone conclusion. As it is with all types of progress, the problems involved are varied and many. The problem of the treatment and disposal of radioactive wastes has been a subject of much discussion. The radioactive contamination of our municipal and industrial water supplies has equally received its share of attention. These problems will tend to increase in magnitude as the sources of radioactive wastes (airborne and waterborne) become more widespread. With the extended use of radioisotopes by medical institutions, research laboratories, and industries, it becomes apparent that the study and evaluation of the contaminants and their effects on our water supplies will require the cooperation of all concerned. Actually, a concerted organized effort is being directed toward this end with the result that extensive studies are being applied to the removal of radioactive contaminants from water systems.

FRANK J. SLABY, Water Supervisor, Riegel Paper Corp., Milford, N. J.

The contamination of water naturally affects the paper mill operations since water is one of the principal raw materials. We might ask ourselves to what extent does radioactive contamination constitute a problem for the paper mill? What is the source of this contamination? What type of paper mill product is affected? These questions only serve to emphasize the need for qualitative and quantitative standards regarding the relationship between radioactive contaminants and (1) the paper mill water supply, (2) the paper mill furnishes, and (3) sensitive paper products.

Röntgen's discovery of x-radiation in 1895 was contemporary with Becquerel's chance observation that pitchblende contained a substance which produced a latent image upon contact with a photographic plate. This discovery of the property of radioactivity has led to the use of photographic processes for protection of radiation laboratory personnel and in the determination of the distribution of radioactive materials on a surface. This latter process is known as autoradiography. Since the film industry uses interleaving paper for the packaging of film it becomes evident that the sensitive interleaving paper should be free from radioactive contamination. If the interleaving paper does becomes contaminated, the radiation present reacts in such a manner as to produce a latent image on the developed film. The interaction involved between the emulsion of the film and the radiation is imperfectly understood. The fact remains, however, that the film becomes spotted and fogged when subjected to radiation. The problem involved then, resolves itself into the removal of the radioactive contaminants from the processed water and, hence, from the interleaving paper.

The principal source of contamination is directly applicable to the testing of atomic weapons by the Atomic Energy Commission. The testing of atomic devices, even as far off as the Pacific area, influences the activity of the paper mill water supply to a certain extent. A greater or lesser degree of activity is experienced, depending on the nature of meteorological conditions. When prevailing winds carry the radioactive-laden clouds from the scene of the burst across the Pacific and central United States to the central area of New Jersey, and when conditions are right for precipitation over the Musconetcong watershed, radioactive fall-out results. Even without precipitation in one form or another, dry fall-out is possible, producing a higher than normal activity in the general area. It should be emphasized here that the contamination levels experienced are not considered "dangerous" to the health of the individual.

Depending then upon the path of the trajectory and the level of activity in the water supply system, contamination of sensitive photographic interleaving paper may result. This is effected since the paper is processed in water, and therefore, fission product activity is capable of being carried through the system. The range of activity encountered thus far does not affect the ordinary paper product mainly because of the paper product's ultimate use.

The first time the Hughesville mill of Riegel Paper Corp. was confronted with serious radioactive contamination was in the early part of 1951. The fall-out of radioactivity during this time reached the proportions where it did constitute a major problem when running photographic black papers. Paper produced during this period was too radioactive for the immediate use of packaging film. Techniques have since been employed which have eliminated the uncertainty of the time for scheduling the running of photographic papers.

One of the first steps taken was to make improvements in the water treatment plant. It was desired to increase the over-all efficiency of the system to remove more effectively the contaminating radioactive particles. Due to the minute size of critical particles encountered (1 to 10 mu), close control was essential in the pretreatment of the raw water. The use of activated silica as a coagulant aid has permitted successful operation of the water treatment plant. It also became necessary to measure the amount of radioactivity in the rain, raw, and processed waters. A control program was initiated to accumulate the necessary data. The program now in progress is set up to correlate the density of radioactive spots on film with the fission product activity of measured quantities of processed water samples. The raw water data merely serve as a preview of the activity that may be found in the processed water system. It became important, therefore, that the proper selection of a monitoring program be made to suit the process requirements for the manufacture of photographic papers by the paper industry. This program would not preclude the checking of other raw materials where the resulting product was used for or with sensitive materials.

At the beginning of the project, it was necessary to develop experimental procedures since there was no standard control in use for the collection and the monitoring of water samples. Therefore, methods and periods of collection, of concentration, and of mounting samples were developed. As the program progressed, refinements were added to continually improve the over-all monitoring procedure.

Basically, the present water monitoring procedure consists in concentrating the activity of the water sample by filtering the water through a suitable filter pad and then monitoring the filter pad with its collected residue. The same procedure is used for all meteorological, raw, and processed water samples. The volumes of the different type samples vary, however. Recent improvements in the filtering capacity of the processed water system allow for a 3000-liter sample to be collected during a 6-hr. period. The sampling period for the processed water samples is always 6 hr. The volume of raw water samples is 4 liters and of rain samples, 2 liters. Normally, all samples are collected once a day. The frequency of sampling actually depends upon whether the status is critical or noncritical in reference to the type of paper being produced by the mill.

After each water sample has been filtered, the filter pad with its collected residue is prepared for mounting by ashing it in a porcelain crucible. The concentrated ash is placed on a filter pad and mounted in the form of a thin circular packet approximately $1^3/_4$ in. in diameter. The prepared mount is then ready for subsequent monitoring.

The monitoring device used is a TGC-2 Geiger Mueller, mica end-window tube designed specifically for low energy beta emitters. Beta particles are essentially the only type radiation considered in exposing film at the low levels of activity encountered. Other type radiations (alpha and gamma radiation) may be neglected due to their specific characteristics. The Geiger tube is used in conjunction with a model 172 ultra-scaler unit. The detector tube is enclosed in a lead container designed to provide shielding from external electromagnetic radiations. The external radiations or more commonly termed "background activity" is that activity in the ambient atmosphere. This activity is due to cosmic rays and the natural activity in the area. An aluminum holder receives the prepared mount and the entire unit is then placed in the lead shield just beneath the tube. The radiations emitted by the radioactive particles cause ionization of the special gas mixture in the Geiger tube. The input voltage pulses caused by the electron avalanche are supplied to the scaler unit which is essentially a mechanical registering device for recording the number of events. When measuring the net activity of a sample the background measurement must always be subtracted from the measurement obtained with the sample.

The two terms "total activity" and "fission product activity" require definement. The term "total activity" is distinguished from "fission product activity" by identifying the time that the reading was taken. "Total activity" refers to the activity of a sample immediately after ashing and mounting. When 6 hr. have elapsed since the sample was ashed and mounted, the reading is termed "fission product activity."

All mounted samples are given a film contact test to determine their spot producibility. This 2-week test is run after the fission activity in the sample has been determined. In this manner we are able to establish some relationship between the activity of the sample and the spot frequency. It must be borne in mind that the entire problem is quite complex and many variations exist. Even the evaluation of the film tests, in many instances, is difficult to make because of spots overlapping or of a predominating background fog, or very slight fog which shows up with the spots.

The sample tolerance was estimated to be 1 count per min. above background in 800 liters of water. Therefore, the minimum size sample that must be processed is 800 liters. This is based on the maximum acceptable defect frequency of the film, the maximum permissible activity level in the water, the effectiveness of the filter pads, and the minimum detectable count of the instrument. Consideration must also be given to the total consumption of water by the mill. In the final analysis a safety factor will have to be included.

Upon examining the data collected to date, it was observed that in the larger volumes of samples collected, count rates often have exceeded the tolerance level without any indication of fission product contamination in the film tests. This was for the processed water samples. This may indicate the possible presence of other radioactive decay products. Rough estimates show that a 10.6-hr. half-life may be present which would indicate radio-thoron decay products. The previously mentioned term "total activity" or short term activity is influenced by radon, an emanation of radium which has a half-life of 3.825 days. The half-life of radon decay products is approximately 0.5 hr. Radon and thoron are both emanations and are decay products of radium and thorium, respectively. In general, then, when a sample is aged for 6 hr, the original radon activity is essentially eliminated [$(1/_2)^{12}$% original radon activity remaining] and, therefore, the term "fission product activity" is used for these samples. In preliminary tests, radon activity was measured to find out to what extent it varied in the area. Recently, the measurement of total activities has been discontinued from the monitoring program.

The film contact tests have shown some correlation with the fission product activities of the samples. During the period prior to March 13, 1954, when the first effects of the hydrogen bomb were felt, less than 1% of the processed water samples showed a spot on film. Many of these exceeded the tolerance limit without producing spots. After March 13, fission product activities of low magnitude have produced spots upon contact with film. The data accumulated to date are not complete enough to definitely establish an activity level to serve as a guide to the mill for the safe production of black photographic paper. The data, however, have shown definite trends and when used in conjunction with meteoro-

logical data have made it possible for us to successfully run black during potentially dangerous periods.

The data collected on the correlation of film spots with activity date back to Dec. 12, 1953. The results of the program will become more significant when more data have been collected and when improved methods are available. The evaluation of the data collected thus far indicates that the level of fission product activity in the processed water producing zero spots on the film test has substantially decreased during the period of atomic tests. The effects of the three (known) hydrogen devices (fired on March 1, March 26, and April 6) have shown three general high peaks of activity. It should be noted that the influence of one or several bursts on the activity of a sample due to meteorological conditions is important and, therefore, should be considered. The type, size, and age of rainfall reflecting the activity in the processed water warrants a separate study. The ultimate size of the sample and its corresponding basis deserves a critical analysis since it presupposes a homogeneous mixture of discrete radioactive particles in the water system.

To add to the complexity of the problem, it was observed that activities of comparatively high levels did not produce spots on film, whereas activities of low levels have produced spots on film. With the eventual accumulation of mass data and the application of statistical analysis to these data, it will be possible to show the varying degrees of risk involved at the activities generally encountered. This is essentially the information desired by Riegel Paper Corp. in order for them to plan successfully and to make photographic black runs without having to shut down or change to a less sensitive product.

The writer wishes to acknowledge the valuable assistance given to Riegel Paper Co. by the technical departments of its customers.

The Value of a Microscope for a Specialty Paper Mill

J. W. JUDGE and B. H. SCHRIER

Riegel Paper Corp. produces annually over 600 grades of paper, using almost every papermaking fiber known to the industry, and employing a large number of papermaking techniques. Consequently, it has been necessary and profitable to employ a microscope in fields other than the quantitative identification of fibers, and in tracing the source of spots in paper.

Because of the multiplicity of fibers and modifiers employed in specialty papermaking today, it has been necessary in our work with the microscope to gather much data, to become familiar with many techniques, and often to develop certain arbitrary standards to be used in the microscopic evaluation of paper. Since the value of a microscope in control and research is no greater than the experience of the analyst, it is the object of this paper to help others in the industry to benefit by our experience.

EQUIPMENT

A description of our laboratory facilities will indicate the type of work which we are prepared to undertake in the microscopy laboratory. Our equipment is located in an essentially dust-free room adjacent to a dark room, which is used for photomicrographic purposes. The more essential equipment is as follows:

1. Two Bausch and Lomb microscopes with movable stages, 32, 16, and 4-mm. objective lenses, 15, 10, 8, and 5X eyepiece lenses, and an optical micrometer.
2. A camera and light source for photomicrographic work.
3. A low-temperature hot-plate and a desiccator for drying slides.
4. An ultraviolet light for spot analysis.
5. A large collection of fiber stains.
6. Various solvents and reagents.
7. Reference material, including John Graff's "Color Atlas for Fiber Identification," Vol. XXV, No. 1, Technical Publication of the State University of New York, College of Forestry, and a series of fiber keys prepared by the university.
8. A complete file of all pulps used by the company and a growing collection of other pulps on the market.

J. W. Judge and B. H. Schrier, Technical Dept., Riegel Paper Corp., Milford, N. J.

CONTROL

Our laboratory is called upon to make up to 100 fiber analyses a month, therefore we necessarily attempt an analysis with as few stains as possible. Most of our routine analyses are made with the Graff C stain. When certain textile fibers are present in a sample, we rely on the du Pont Fibrotint or a Ciba stain.

Because we depend so much on the C stain, we have been moved to gather more data than can be derived from Graff's color charts. The following are descriptions of color reactions that we have observed while using the C stain:

1. Hardwood semichemical pulps are characterized by the range of colors to be found amoung the tracheids. Unbleached semichemical will display pink, yellow and green fibers, while bleached samples will contain more deep blackish blue fibers and less pink and yellow ones. It must be said that there is much to be learned concerning the identification of semichemical pulps; the distinction between bleached and unbleached fiber is a fine one that requires much experience on the part of the operator.

2. Krafelted wood fiber and cotton linters, which have been given a quick treatment with strong caustic, appear swollen almost beyond recognition, but the deep blue-purple color is easily observed. Parchmentized fiber stains in a similar manner, but appears mechanically mutilated, and can sometimes be identified by the presence of lighter-colored areas across a fiber, which result from fiber-to-fiber contact before parchmentizing.

3. A low-alpha, or alpha-treated kraft does not usually display the alpha color as described by Graff. The color reaction resembles that of bleached kraft with the exception that a small percentage of the fibers appear a dark purple.

4. Some artificial textile fibers may be identified with some certainty using the C stain; it is wise to supplement the observation with a textile stain. We have found it necessary to allow the stains to "set" for at least 3 min. because so many textile fibers are treated in such a way that they do not color rapidly. Viscose rayon has been observed to stain red to deep purple, and is recognized by its rugose surface. Acetate rayon will stain amber to brown, and usually appears to be full of specks (probably titanium dioxide or other delustrant). By placing a drop of methyl ethyl ketone under the cover glass, acetate rayon will be observed to dissolve rapidly, leaving behind the inclusions. The newer nitrogenous fibers and wool stain yellow to brown, but are very seldom encountered.

5. Carboxy-methyl cellulose and hydroxy-ethyl cellulose will stain blue under C stain, and, if present in a sample in quantities which can be observed, will exhibit a tendency toward a crystalline appearance. All noncellulosic materials that we have observed, such as resins, rubbers, and size, will stain yellow to brown. We have found that it is possible to tell the difference between papers saturated with resin or latex, and papers containing precipitated latex or resin.

COMPLAINT ANALYSES

In the analysis of a complaint sample, or a sample of unknown origin, it is often true that the gross fiber analysis proves to be less important than the detection of certain trace fibers in the sheet. It has been noted that certain mills invariably have traces of some atypical fiber present

in their systems at all times; to make use of this feature, it is necessary to obtain bona-fide samples of competitive papers and to have a collection of the pulps in use in one's own mill.

We have found it necessary to develop a standard procedure for the fiber analysis of complaint samples. First, the slides are prepared under conditions which will minimize contamination. Then an over-all examination of the stained specimen is made under the 32-mm. objective. A fiber analysis is made using the 16-mm. objective, and any anomalies are noted. The species of each type of fiber is determined using the keys and photomicrographs from our reference material. The same procedure is followed on samples from the same run and reels as were mentioned in the complaint, to check against an error in finish.

It has been possible in the past to prove not only that a complaint paper was not made in our mills, but to tentatively name the mill that did produce the paper. It has been gratifying indeed when subsequent correspondence with the customer proves us correct.

It must be mentioned that the identification of species from the beaten fiber is one of the most important and most difficult tests in a fiber analysis. The fiber keys in use in our laboratory have proved invaluable; they were composed quite recently, and are not as yet available in published form.

RESEARCH

The microscope is used at Riegel in many phases of research, as well as in control work. Much of this work follows the literature and standard techniques:

1. In investigations of the precipitation of resins, latices, and sizes, it is common to measure the particle size of the precipitate to substantiate other data.
2. In the identification and examination of paper coatings, we have made some observations; the preparation of sections mounted in wax has been limited for want of a microtome.
3. In the investigation of felt and wire life, it is possible to observe the type of deterioration which is taking place. In the course of this work, photomicrographs are commonly used to illustrate reports of the findings of the analyst. Standard methods of staining felts for this purpose are employed.
4. Microscopic examination of the encrustants which build up on suction boxes, on doctors, and in tanks and piping has served to supplement the data obtained in our analytical laboratory.

At present we are engaged in a microscopic study of refining and refining methods. The problem is one of obtaining greaseproofness without the sacrifice of other properties. It is known that some types of refining will give greaseproofness at a higher freeness than other methods; it has also been observed that a given refiner will produce a greaseproof stock from one pulp and will not produce comparable results from another pulp, even though the hemicellulose content of both pulps is comparable.

In the course of this study, we have been able to illustrate with the miscroscope that: (1) dissimilar fibers in a mixed furnish will beat differently; (2) it is possible to evaluate quantitatively, by means of an arbitrary system, the difference between two methods of refining; (3) for a given fiber refined by a given method, it appears possible to estimate the freeness of a sample with a fair degree of accuracy.

The work done so far has been based on fiber length distribution curves and the statistical evaluation of an arbitrary method of determining the amount of mechanical energy put into a fiber.

The input of mechanical energy was measured by counting the number of cut ends, balloons, and ruptures of the fiber wall, per millimeter of length. Through statistical methods, a figure was obtained which was designated as "mean ruptures per millimeter." It was found that when this figure was obtained for a given pulp through a wide freeness range, a sigmoid curve similar to the beating time curve of the pulp in slope and inflection was obtained.

When the graphical distribution of this figure was made, it was found that the shape of the curve was descriptive of the type of refining action employed.

This work is still in progress; the microscopic study as described is admittedly tedious and time-consuming. However, it is hoped that when the data on physical tests, four-screen fractionation, greaseproofness, and density are substantiated by our data on the mean fiber length, mean ruptures per millimeter, the resultant curves and photomicrographic illustrations, it will be possible to determine accurately the characteristics of a refiner, and to alter these characteristics to obtain a desired result.

There is much to be learned about fiber analysis and the microscopic evaluation of paper. For instance, when a pulp suspension has been dried on a glass slide, a ring is formed around the edge of the water droplet which contains a concentration of all the soluble matter present in the sheet. Under the C stain, it is possible to detect the presence of starch in this ring by its typical color reaction with the iodine in the stain.

In the course of analyzing a series of paper samples for a certain law-enforcement agency, this laboratory noted the presence of cubic crystals in great number in this so-called evaporation ring. Nothing of this sort had ever been seen by our three fiber analysts; alum is the most common salt added to paper, but we could not believe that alum would be present in sufficient quantities to be seen, and of course any crystals which could be formed would most logically be other than cubic. Near the end of the investigation, it was learned that the paper in question had been treated with a silver nitrate solution to bring out fingerprints, and a quick check showed that that was what we had observed.

1 INSTRUMENT *for Testing* smoothness porosity softness

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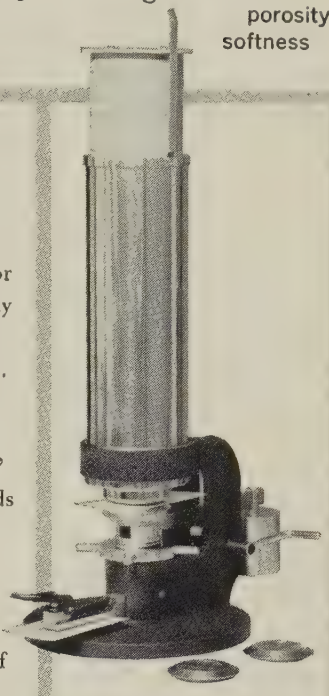

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UNITED STATES PATENTS ON PAPERMAKING

Fourth Quarter, 1954 — *Compiled by The Institute of Paper Chemistry*

THE following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D.C., by sending twenty-five cents for each patent desired.

October 5, 1954

Bletzinger, John C., and Sager, Karl E. Tampon and tampon applicator assembling method. U.S. patent 2,690,598. Filed May 16, 1949. 4 claims. Assigned to International Cellucotton Products Co. [Cl. 19-144.5.] Method of handling the drawstring of a tampon during assembly in the applicator tube.

Dazey, Harry D. Envelope box display. U. S. patent 2,690,-625. Filed July 21, 1952. 4 claims. [Cl. 40-121.] Envelope container in conjunction with calendar or advertisement to form a shipping and display package.

Gransten, Folke. Straight edge guided manual trimming device for sheet material. U. S. patent 2,690,805. Filed July 27, 1950. 1 claim. [Cl. 164-73.] Razor blade mounted on a cutter for trimming wallpaper or the like.

Greiner, Charles J., Graef, John M., Collins, Howard A., Burger, William H., and Sabee, Reinhardt, N. Method and apparatus for making catamenial tampons. U. S. patent 2,690,597. Filed July 1, 1948. 20 claims. Assigned to International Cellucotton Products Co. [Cl. 19-144.5.] Device for lateral and transverse compression of tampon units before insertion in applicator tube.

Kirby, Michael J. Box. U. S. patent 2,690,866. Filed Aug. 19, 1948. 2 claims. Assigned 50% to R. H. Filmer Ltd. [Cl. 229-28.] Cardboard tube is provided with score and fold lines such that portions of the top and side walls fold down to form partial end walls and a transverse partition.

Lührmann, Fritz, and Klein, Ernst. Method for the production of paper bags. U. S. patent 2,690,706. Filed Oct. 18, 1950. 7 claims. Assigned to Bischoff & Klein. [Cl. 93-35.] Scoring rolls define fold lines in sheet of bag paper which is then passed between folding rolls to form bag tube and bottom in a single operation.

Potts, Roy C. Detachable handle-means for packages. U. S. patent 2,690,867. Filed Feb. 21, 1950. 20 claims. [Cl. 229-52.] Loop-shaped elements with inwardly projecting legs are attached at either end of a flexible strap handle with the legs engaging the carton or bag walls when the strap handle is lifted.

Robinson, Howard M. Package. U. S. patent 2,690,839. Filed June 10, 1950. 3 claims. Assigned to Armour and Co. [Cl. 206-47.] Sleeve-type can holder.

Tepper, John J. Combination toilet tissue package. U. S. patent 2,690,838. Filed Feb. 28, 1950. 1 claim. [Cl. 206-47.] Parchmentized paper sheet is used for wrapper to protect toilet tissue roll and serve purchaser as a washing or polishing cloth.

Voet, Andries. Printing ink and varnish therefor. U. S. patent 2,690,973. Filed April 17, 1954. 8 claims. Assigned to J. M. Huber Corp. [Cl. 106-20.] Alkali lignin is dissolved in glycol or formamide and the lignin salt formed with a nitrogenous base such as ammonia. Inks produced with this varnish tolerate large amounts of water and will not smear or rub.

October 12, 1954

Baier, Ludwig S. Log barge. U. S. patent 2,691,355. Filed April 21, 1952. 9 claims. [Cl. 114-27.] Carrying part of a load of logs or timbers in pockets alongside a barge is utilized to increase the capacity of the barge and make a more stable and seaworthy load.

Baumann, Martin M. Pallet. U. S. patent 2,691,500. Filed Feb. 7, 1952. 1 claim. Assigned to International Paper Co. [Cl. 248-120.] Support legs for a paperboard pallet are threaded to the base sheet with a locking strip of board.

Boeye, Paul F., and Bright, Samuel. Battery box. U. S. patent 2,691,480. Filed April 2, 1953. 5 claims. [Cl. 229-44.] Extensions of the sidewalls and the top are doubled to protect the battery terminals.

De Pan, Raymond T. Apparatus for removing rags from stock pulpers. U. S. patent 2,691,324. Filed March 29, 1951. 7 claims. Assigned to Downingtown Manufacturing Co. [Cl. 92–28.] Conveyor-mounted spikes project into the pulper vat through a vertical slot and carry engaged rags upward and out of the vat.

Evers, Arthur J. Adjustable roll mounting for bagmaking machines. U. S. patent 2,691,328. Filed April 3, 1952. 3 claims. Assigned to International Paper Co. [Cl. 93-8.] Bearing block with internal spring loading may be positioned in bearing slideway and still provide loading tension on the roll.

Evers, Arthur J. Flap folding mechanism for bagmaking machines. U. S. patent 2,691,329. Filed June 2, 1952. 11 claims. Assigned to International Paper Co. [Cl. 93-27.] Folds in bag bottoms are made by sweep arms mounted adjacent the bag-carrying drum for vibrationless, high speed operation.

Forrer, Homer W. Paperboard box structure. U. S. patent 2,691,471. Filed Aug. 22, 1950. 2 claims. Assigned to Atlanta Paper Co. [Cl. 224-45.] Integral handle in center of one panel is doubled and adhesively secured and folds flat against the panel.

Geisler, William. Method of making and filling cartons. U. S. patent 2,691,258. Filed Dec. 22, 1949. 7 claims. [Cl. 53-7.] Carton contents in a block are inserted into inverted container, then the cover flaps closed and sealed.

Gettelman, Gilbert C. Container for fragile cookies or the like. U. S. patent 2,691,441. Filed May 19, 1951. 3 claims. Assigned to Charles A. Wilkinson. [Cl. 206-72. .] Cookies are held in a multipocket envelope which is supported between cookies by a slotted partition structure.

Hawley, Mones E. Envelope assembling apparatus. U. S. patent 2,691,327. Filed Aug. 27, 1953. 6 claims. Assigned to Radio Corporation of America. [Cl. 93-1.] Envelopes are placed in a chain by passing each end through a loop in a tape.

Huebner, William C. Method and apparatus for printing or coating. U. S. patent 2,691,343. Filed March 17, 1949. 54 claims. Assigned to The Huebner Co. [Cl. 101-116.] Coating or printing fluid is introduced into the annular space between an inner shell and the pervious cover of the transfer cylinder. An electrostatic field at the point of web contact causes transfer of the fluid to the web.

McArn, Theodore A. Roll pressure indicating and controlling system. U. S. patent 2,691,326. Filed Dec. 6, 1949. 6 claims. Assigned to Downingtown Manufacturing Co. [Cl. 92-49.] Electrical strain gage in journal mounting is connected to a means of automatically controlling pressure at each end of press roll.

Robbins, Henry. Paper shredding and baling machine. U. S. patent 2,691,338. Filed Aug. 7, 1950. 4 claims. [Cl. 100-97.] Paper is shredded between rolls made up of spaced disks and delivered to a bin where a pressure plate compresses the material at intervals.

Schlemmer, Philip G. Machine for sealing cartons and the like. U. S. patent 2,691,260. Filed April 24, 1951. 19 claims. [Cl. 53-45.] Adhesive is applied to the flaps of a filled container, the flaps folded to the sealed position, and the container passed between a series of upper and lower rollers to apply pressure on the flaps until the adhesive has set.

Shepard, Ernest L. Pocketed egg tray. U. S. patent 2,691,456. Filed Aug. 14, 1952. 3 claims. Assigned to Keyes Fibre Co. [Cl. 217-26.5.] Molded pulp egg separator tray.

Townsend, Edward. Screen. U. S. patent 2,691,325. Filed Sept. 2, 1953. 1 claim. Assigned to The Sandy Hill Iron & Brass Works. [Cl. 92-31.] Separator strips between screen plates are pulled downward by wedge-shaped projection on the clamping bar for easy assembly or removal of the screen plates.

Vogt, Clarence W. Method of and apparatus for forming packages. U. S. patent 2,691,257. Filed Dec. 2, 1949. 14 claims. [Cl. 53-6.] Printed and scored wrapper is formed into a pair of V-shaped troughs on either side of a supporting belt and plastic material (e.g., ice cream) deposited in the troughs by twin feed heads.

Watts, Russell E. Load supporting pallet. U. S. patent 2,691,499. Filed April 3, 1950. 9 claims. Assigned to Fleming & Sons, Inc. [Cl. 248-120.] Chipboard bases are spaced apart by

legs formed from a combination of circular and square tubes with internal arcuate interlocking stiffeners.

Yeadon, Donald J., Hooker, Leland W., and Garland, Hereford. Method and apparatus for stripping bark. U. S. patent 2,691,395. Filed July 26, 1951. 24 claims. Assigned to Board of Control of the Michigan College of Mining & Technology. [Cl. 144-208.] Stripping knives supported in an annular ring cut and strip the bark from logs forced through the ring. Power consumption is claimed very low for bark removal.

Ziliox, Thomas L., and Taylor, William P. Process of finishing paper. U. S. patent 2,691,606. Filed Dec. 7, 1951. 6 claims. Assigned to The Champion Paper and Fibre Co. [Cl. 117-65.] Coated paper with an improved surface and a reduced tendency to scale during calendering is made by treating the surface with an aqueous oleaginous emulsion just prior to calendering.

October 19, 1954

Arena, Anthony E. Plant protector. U. S. patent 2,691,848. Filed Oct. 29, 1951. 2 claims. [Cl. 47-26.] Paper or plastic cover with one movable wall which can be opened for ventilation.

Bryan, Collis C. Manufacture of vanillin from lignin. U. S. patent 2,692,291. Filed June 6, 1950. 8 claims. Assigned to Monsanto Chemical Co. [Cl. 260-600.] Concentrated spent sulphite liquor in alkaline solution is reacted with oxygen under controlled conditions of partial pressure to obtain increased yields of vanillin.

Clancy, Robert F. Electrolytic recording paper. U. S. patent 2,692,228. Filed Dec. 29, 1950. 4 claims. Assigned to Faximile, Inc. [Cl. 204-2.] Impregnating solution for facsimile recording paper claimed to be nonblocking and free from bleeding.

Ericks, Walter P. Method for treating cellulose and product thereof. U. S. patent 2,692,183. Filed July 7, 1949. 8 claims. Assigned to The Upson Co. [Cl. 8-115.6.] Stability of cellulosic boards to changes in atmospheric humidity is increased by impregnation of the board with a hydroxy carboxylic acid such as lactic or gallic acid, then heating and drying at 100–200°C.

Harker, Charles B. Bag closing mechanism. U. S. patent 2,691,857. Filed Feb. 19, 1953. 9 claims. Assigned to Bartelt Engineering Co. [Cl. 53-144.] Device stretches the upper trailing edge as the bag approaches the bag closing station to make a smooth seal possible.

Jensen, Thormod, and Waite, Fred L. Wrapper tear tab forming mechanism. U. S. patent 2,691,856. Filed Sept. 2, 1949. 26 claims. Assigned to American Machine & Foundry Co. [Cl. 53-61.] Tear strip incorporated with a wrapping is extended the same distance past the edge of the wrapping regardless of the length of successive wrappings.

Klein, David X., and Curgan, Mark N. Softener and flame-resistant coating composition, method of its application to cellulosic materials and the article produced thereby. U. S. patent 2,692,203. Filed Jan. 16, 1951. 18 claims. Assigned to Heyden Chemical Corp. [Cl. 106-15.] Composition containing urea, glycerin, and phosphoric acid is claimed to soften paper or fabric, and at the same time render the material flameproof.

Kuhlman, Richard. Package for radio tubes and the like. U. S. patent 2,692,077. Filed Dec. 11, 1948. 1 claim. Assigned to Radio Corporation of America. [Cl. 229-14.] Frustum-shaped inner sleeve for a radio tube package contains two cut sections to engage the contact prongs.

Labino, Dominick. Method for making glass paper. U. S. patent 2,692,220. Filed Nov. 19, 1951. 4 claims. Assigned to Glass Fibers, Inc. [Cl. 154-101.] Streams of molten glass are passed between draw rolls then directed onto the forming wire by an air blast. An aqueous acid bath increases the matting of fibers in the sheet.

Lange, Ferdinand. Box. U. S. patent 2,692,078. Filed May 19, 1950. 1 claim. Assigned to Werner Bahlsen. [Cl. 229-16.] Corners are folded in triangular pleats to ensure moistureproof side seams.

McEwen, Robert L., and Sheldon, Fred R. Treatment of unbleached sulphite pulp. U. S. patent 2,692,181. Filed March 8, 1950. 4 claims. Assigned to Buffalo Electro-Chemical Co. [Cl. 8-104.] Bleaching at temperatures under 130°F. at consistencies of 20–65% for from 1 to 20 days with an alkaline peroxide using from 0.3 to 1.75% hydrogen peroxide based on the dry pulp is claimed.

Mueller, William G., Cherepow, Frederic H., Bartes, August, Jr., and Klause, Karl. Apparatus for evacuating and heat-sealing packages. U. S. patent 2,692,074. Filed Aug. 14, 1952. 10 claims. Assigned to Marathon Corp. [Cl. 226-56.]

Othmer, Donald F., Mellenger, Edmund R., and Smith, Warren R. Process of making water-resistant molded lignocellulose. U. S. patent 2,692,206. Filed May 11, 1951. 2 claims. [Cl. 106-163.] Comminuted cellulosic material together with from 3 to 6% sulphur molded at elevated temperatures and pressure produces water-resistant products.

Pearce, Lewis C. Method and apparatus for packaging envelopes. U. S. patent 2,691,922. Filed Nov. 12, 1953. 10 claims. Assigned to Pearce Development Co. [Cl. 93–1.] Adhesive band is applied to edges of envelope pack to hold pack together, then groups of the desired number are removed by slitting the adhesive band.

Stayner, Richard D., and Johnson, Gordon B. Microbiocidal water treatment. U. S. patent 2,692,231. Filed Sept. 5, 1950. 5 claims. Assigned to California Research Corp. [Cl. 210-23.] Microbiological organisms in paper mill white water may be controlled by addition of 50–250 p.p.m. of a composition consisting of equal parts of a long-chain alkylbenzyl trimethyl ammonium halide and pine oil.

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Capell, Robert G., Ridenour, William P., and Steward, John A. Paraffin wax compositions. U. S. patent 2,692,835. Filed June 7, 1950. 6 claims. Assigned to Gulf Research & Development Co. [Cl. 106-270.] An inhibitor comprising bis (2-hydroxy-3-*t*-butyl-5-methylphenyl) alkane is added to molten paraffin wax to prevent decomposition in the molten bath.

Elsman, James L. Sealed package. U. S. patent 2,692,723. Filed June 21, 1949. 6 claims. Assigned to Kalamazoo Vegetable Parchment Co. [Cl. 229-87.] Bread wrapper label strip with thermoplastic adhesive on one side may be printed at time of use.

Frey, Kenneth. Carton metering insert for granular materials. U. S. patent 2,692,708. Filed July 12, 1949. 4 claims. [Cl. 222-456.] Paperboard insert along two walls of a granulated soap carton provides a means of controlling and metering flow of material from the container.

Gray, Kenneth R., Thomas, Berwyn, B., and Schlosser, Paul H. Acetylation of wood pulp. U. S. patent 2,692,877. Filed May 11, 1951. 8 claims. Assigned to Rayonier Inc. [Cl. 260-229.] Surface-active agents are added to pulp for acetylation to facilitate wetting of the fiber with the acetylating agent.

Johnson, Leonidas E. Container with cover lock. U. S. patent 2,692,722. Filed July 9, 1953. 7 claims. Assigned to Container Corporation of America. [Cl. 229-45.] Triangular folds at corners of body and cover provide locking means.

Kowal, Michael H. Bottle carrier. U. S. patent 2,692,700. Filed June 16, 1948. 9 claims. Assigned to Empire Box Corp. [Cl. 220-113.]

Leffler, Nils G. Debarking machine having bark-removing members yieldably connected to centrifugally actuated weights. U. S. patent 2,692,623. Filed March 21, 1952. 7 claims. Assigned to Svenska Cellulosa Aktiebolaget. [Cl. 144-208.] Scraping tools are carried on a rotating drum through which the logs are passed.

Lighter, Stephen. Bottle carrier. U. S. patent 2,692,701. Filed Oct. 29, 1951. 6 claims. [Cl. 220-113.]

Pennebaker, Lewis C., and Johnson, Leonidas E. Closure and fastener for cartons. U. S. patent 2,692,721. Filed May 10, 1951. 2 claims. Assigned to O. B. Andrews Co. [Cl. 229-45.] Paperboard carton for popcorn is provided with automatic bottom and a full cover held in closed position by tabs in the slotted side walls.

Rupp, William C. Combined safety stop and brake means for paper-cutting machines. U. S. patent 2,692,668. Filed Feb. 8, 1951. 9 claims. Assigned to The Chandler & Price Co. [Cl. 192-148.] Positive stop arrangement is engaged in event of brake failure to prevent repetition of knife cutting cycle until released by the operator.

Sidman, Harry W. Blank feeding mechanism with breaker unit. U. S. patent 2,692,774. Filed July 3, 1951. 6 claims. Assigned to American Can Co. [Cl. 271-18.] Vibrating plunger extending through the magazine wall causes lateral displacement of the blanks as they descend toward the feed element to break apart blanks that may have struck or blocked together.

Suess, Ralph T., and Shepard, Donald Co. Shipment corner protector. U. S. patent 2,692,720. Filed June 23, 1952. 1 claim. Assigned to Menasha Wooden Ware Corp. [Cl. 229-14.] Multilayered piece of corrugated board is cut to fold about a hinge, then the lower part of the sides cut and folded inward 180° to form a bottom support.

Wilcox, Isaac L., Barnes, Alfred A., Patch, Clarence E., and Spurr, Robert. Machine for closing cartons. U. S. patent 2,692,463. Filed May 8, 1948. 25 claims. Assigned to Oswego Falls Corp. [Cl. 53-44.] Mechanisms for automatically forming, sterilizing, applying, and sealing end and top closures to a moving line of open-ended paperboard cartons, for packaging fluid and semifluid products.

Yaeger, Henry. Fabric-lined box. U. S. patent 2,692,696. Filed June 3, 1953. 7 claims. Assigned to U. S. Basket Co., Inc. [Cl. 217-3.] Method of attachment of fabric lining to cardboard blanks.

Yarber, Clifford J. Sizing paper pulp. U. S. patent 2,692,824. Filed Sept. 28, 1949. 1 claim. Assigned to A. M. Meincke & Son, Inc. [Cl. 92-21.] Cold swelling starch is made by acidifying

to a pH of 5.2–6.2 with monosodium phosphate, then heating and drying the product.

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Bolding. Hubert V. Bottle loading carton. U. S. patent 2,693,297. Filed Aug. 10, 1949. 6 claims. Assigned to the Bradley & Gilbert Co. [Cl. 220-113.] Fully partitioned bottle carrier.

Davis, Harold C., and Claridge, Robert A. Apparatus for packaging a soft resilient body. U. S. patent 2,693,304. Filed Nov. 18, 1950. 2 claims. Assigned to Bemis Bro. Bag Co. [Cl. 226-18.]

Fortress, Fred. Glazing batting materials. U. S. patent 2,693,432. Filed Jan. 25, 1951. 9 claims. Assigned to Celanese Corporation of America. [Cl. 154-137.] A solution of urea, boric acid or acetamide is sprayed onto the surface of batting material and the latter contacted with a heated surface. Cellulose fibers are coalesced at the surface only.

Frost, Orcutt W. Hot plate press loader. U. S. patent 2,693,135. Filed March 15, 1949. 33 claims. Assigned to Stimson Lumber Co. [Cl. 92-39.] Apparatus for loading and unloading a hardboard hot press.

Giroux, Alexander, L., and Aquino, Salvatore A. Multicompartment shipping carton. U. S. patent 2,693,308. Filed Feb. 11, 1950. 3 claims. Assigned to The Hinde & Dauch Paper Co. [Cl. 229-28.] Partitioned shipping container for glassware.

Giroux, Alexander L., and Aquino, Salvatore A. Multicompartment shipping carton. U. S. patent 2,693,309. Filed June 19, 1951. 4 claims. Assigned to The Hinde & Dauch Paper Co. [Cl. 229-28.] Very similar to U. S. patent 2,693,308.

Goodwin, Carl W. Cap for paper cups. U. S. patent 2,693,307. Filed Feb. 9, 1953. 3 claims. Assigned to American Seal-Kap Corporation of Delaware. [Cl. 229-5.5.]

Hoover, Keith, S., and Anderson, Bror E. Method of making stencil sheets and resultant article. U. S. patent 2,693,426. Filed Nov. 1, 1950. 8 claims. Assigned to A. B. Dick Co. [Cl. 117-35.5.] Increased durability for use with water-base inks is obtained by coating porous base sheets with cellulose nitrate, phenol, and a polymerizable reaction product of an aromatic vinyl compound.

Jelstrup, Gunnar. Disposable robelike garment. U. S. patent 2,692,989. Filed Oct. 10, 1949. 1 claim. [Cl. 2-114.]

Palmer, Frank D. Bottle carrier. U. S. patent 2,693,298. Filed June 10, 1952. 5 claims. Assigned to Package Machinery Co. [Cl. 220–118.]

Prescott, Charles J., Jr. Sized paper product, size, and method of making the same. U. S. patent 2,693,424. Filed Dec. 28, 1951. 3 claims. Assigned to Bennett Inc. [Cl. 106-230.] An emulsion made up by adding rosin and hydrocarbon wax to spent sulphite liquor is used as an acid-stable, soap-free sizing for paper.

Schneider, Charles H. Process for improving the brightness of clay. U. S. patent 2,693,319. Filed Oct. 10, 1950. 3 claims. Assigned to Minerals & Chemicals Corporation of America. [Cl. 241-21.] The brightening of kaolinite containing iron-bearing titanium mineral is effected by dispersing the clay in an inter heavy medium and subjecting the mineral matter to shear.

Schur, Milton O. Method of adding extra filler to the edges of paper. U. S. patent 2,693,415. Filed April 10, 1951. 2 claims. Assigned to Ecusta Paper Corp. [Cl. 92-21.] More uniform distribution of filler is claimed by adding a portion of the filler slurry to the edges of the stream of stock in the headbox prior to flowing onto the fourdrinier.

Stopper, Charles A. Paper box construction. U. S. patent 2,693,310. Filed Sept. 19, 1950. 3 claims. Assigned to Diamond Paper & Box Co. [Cl. 229-53.] A completely closed fiberboard box is provided with a handle.

Williams, Victor G. Bag-making, filling, and closing apparatus. U. S. patent 2,693,067. Filed Dec. 17, 1952. 18 claims. Assigned to Delamere & Williams Co. ,Ltd. [Cl. 53-86.] Operation involves tea bags or the like.

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Bay, Ernest. Apparatus for reinforcing sheet material. U. S. patent 2,693,844. Filed Dec. 30, 1950. 3 claims. Assigned to Owens-Corning Fiberglas Corp. [Cl. 154-1.76.] A random-pattern, strand-feeding machine is used in conjunction with a paper laminator for laying reinforcing material on a continuous web of paper.

Capell, Robert G., Ridenour, William P., and Steward, John A. Paraffin wax compositions. U. S. patent 2,694,014. Filed May 16, 1950. 4 claims. Assigned to Gulf Research & Development Co. [Cl. 106-270.] Addition of 0.0005–0.01% by weight of alpha-conidendrol to paraffin wax is claimed to inhibit oxidative deterioration at elevated temperatures.

Cooper, Basil P., Clark, Kenneth, J. B., and Bradshaw, Arthur. Apparatus for making shoe stiffeners. U. S. patent 2,693,740. Filed Nov. 22, 1949. 2 claims. Assigned to United Shoe Machinery Corp. [Cl. 92-54.] Apparatus for forming shoe counters and other shoe stiffening members from a pulp slurry.

Elmendorf, Armin. Improvement in boxes. U. S. patent 2,693,894. Filed July 31, 1948. 4 claims. [Cl. 217-17.] A shipping container with two layers of board and an inner layer of veneer strips.

Elmendorf, Armin. Shipping container. U. S. patent 2,693,895. Filed June 19, 1950. 7 claims. [Cl. 217-17.] A shipping container with veneer strips between board layers permits mailing of cleats and end-reinforcing strips.

Geisler, William. Carton closing apparatus for packaging machines. U. S. patent 2,693,671. Filed Oct. 9, 1951. 23 claims. Assigned to Economic Machinery Co. [Cl. 53-44.] The machine closes and adhesively seals a setup carton which has been filled through an open side.

Goss, Worth C. Method of and apparatus for the forming of fiber pads for board making. U. S. patent 2,693,619. Filed May 29, 1950. 9 claims. Assigned to The Sheetwood Products Co. [Cl. 19-155.] The method comprises means for laying down the fibers in an open box, gently prepressing the fibers in the box to give them uniform density, and trimming or brushing off the irregular top surface of the pad to give the desired thickness.

Goss, Worth C. Glue. U. S. patent 2,694,013. Filed Dec. 18, 1951. 3 claims. Assigned to The Sheetwood Products Co. [Cl. 106–163.] Several compositions of glue are given consisting largely of brown rotted wood, ammonia, and an amide such as urea, dicyanamide, melamine, or biuret.

Hartman, Joseph A. Separating and stacking machine. U. S. patent 2,693,742. Filed Feb. 9, 1951. 6 claims. Assigned to American Box Board Co. [Cl. 93-36.] The machine separates a folded double-carton paperboard structure into two cartons in flat folded condition and stacks them.

Jones, Dwight E. Refiner. U. S. patent 2,693,738. Filed May 28, 1952. 1 claim. Assigned to E. D. Jones & Sons Co. [Cl. 92-26.] A pulping machine utilizes a helically ribbed hollow cylindrical rotor to direct the stock to disk elements at the ends of the rotor.

Jorgensen, Julius. Wrapper blank feeding mechanism. U. S. patent 2,693,956. Filed Oct. 16, 1952. 1 claim. Assigned to Brandt Automatic Cashier Co. [Cl. 271–2.6.] An improved blank feeding mechanism forms wrappers for coins, etc.

Okawa, Risaku, and Okawa, Riichiro. Papermaking machinery. U. S. patent 2,693,739. Filed Oct. 1, 1951. 20 claims. [Cl. 92-39.] A sheet-forming machine for making heavy paper from thick solutions without the use of wires or screens.

Junco, Louis. Control circuit for sheet feeding and stacking apparatus. U. S. patent 2,693,885. Filed Oct. 8, 1951. 18 claims. Assigned to Universal Corrugated Box Machinery Corp. [Cl. 214-6.] The control circuit claimed (with automatic as well as manual portions) operates a sheet feeding and stacking apparatus without requiring the use of microswitches or photoelectric cells.

Perry, James H. Pulpstone. U. S. patent 2,693,670. Filed Dec. 19, 1952. 2 claims. Assigned to Norton Co. [Cl. 51–168.] An improved mounting for a segmental pulpstone.

Ross, Colin A. Carton for packing boxes in units of five. U. S. patent 2,693,902. Filed Oct. 9, 1950. 2 claims. Assigned to Behr-Manning Corp. [Cl. 229-27.] Partitions divide shipping container to fit five units in a layer.

Schlumbohm, Peter. Filter paper blank. U. S. patent 2,693,883. Filed April 3. 1952. 1 claim. [Cl. 210–203.] A semicircular filter paper blank for use in filtering coffee in a 30° funnel is claimed.

Speicher, Matz A., and Eshleman, Charles I. Machine and method for sleeving valved bags. U. S. patent 2,693,741. Filed Nov. 22, 1948. 19 claims. Assigned to Hest Machines, Inc. [Cl. 93-8.] A simple, efficient, low-cost machine automatically forms individual sleeves from a long paper strip and then inserts them into valved bags.

Welsh, Ormonde P. Envelope machine. U. S. patent 2,693,957. Filed June 19, 1951. 11 claims. [Cl. 271-12.] An apparatus for feeding single envelope blanks uniformly at high speeds from a stack of blanks to high-speed envelope forming machines, and for adding blanks to the stack without interrupting operations.

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Beachler, Edward D. Vertical transfer suction press assembly. U. S. patent 2,694,348. Filed Sept. 27, 1950. 4 claims. Assigned to Beloit Iron Works. [Cl. 92-49.] Each side of the paper is subjected to vacuum more than once; a vertical-nip, double-suction press is interposed between the presses.

Bock, Louis, H., and Carlson, Lewis J. Phenolic ether dialdehydes. U. S. patent 2,694,731. Filed May 7, 1953. 2 claims. Assigned to Rayonier, Inc. [Cl. 260-600.] Vanillin obtained from spent sulphite liquor is used in the preparation of intermediates for thermosetting resins.

Bock, Louis, H., and Carlson, Lewis J. Phenol ethers. U. S.

patent 2,694,737. Filed May 7, 1953. 2 claims. Assigned to Rayonier Inc. [Cl. 260-613.] This is similar to U. S. patent 2,694,731.

Brock, Peter R., and Druckenmiller, Stanley T. Apparatus for making shoulder boxes. U. S. patent 2,694,197. Filed Jan. 22, 1953. 3 claims. Assigned to E. I. du Pont de Nemours & Co. [Cl. 1-11.] Modification of stitcher regulates differences in line of abutment on shoulder boxes.

Crane, William B., Jr. Article carrier. U. S. patent 2,694,488. Filed June 30, 1949. 4 claims. [Cl. 206-65.] Carrier handle adhesively secured to tops of cans.

Goodwillie, John E. Web transfer assembly. U. S. patent 2,694,346. Filed March 25, 1950. 6 claims. Assigned to Beloit Iron Works. [Cl. 92-49.] Gaseous blasts effect the transfer of the web from wire to dandy roll and then onto the felt; the web is supported throughout the transfer.

Gyŏrgy, Paul, Kuhn, Richard, and Zilliken, Friedrich. Food compositions. U. S. patent 2,694,640. Filed April 22, 1952. 4 claims. Assigned to American Home Products Corp. [Cl. 99-54.] Hydrolyzed chitin (0.1–5% by weight) is added as a growth-promoting source to an infant-feeding composition.

Hjulian, Julius A. Method for producing cement pipes. U. S. patent 2,694,349. Filed June 25, 1949. 7 claims. Assigned to Crane Co. [Cl. 92-59.] Method and apparatus for extrusion molding of cement pipe from slurry of cement, asbestos, and water under high pressure.

Holgersson, Sigbjörn P. H. E., Rudberg, Mac S., and Rydberg, David R. Digester for cooking cellulose. U. S. patent 2,694,632. Filed Nov. 2, 1948. 5 claims. Assigned to Storviks Sulfit Aktiebolag. [Cl. 92–19.] Digester which may be subjected to subatmospheric pressures comprises outer rigid casing spaced apart from inner liner of thin stainless steel.

Hornbostel, Lloyd. Water removal device for paper forming wire. U. S. patent 2,694,345. Filed Jan. 7, 1950. 6 claims. Assigned to Beloit Iron Works. [Cl. 92–44.] An impermeable belt forms a reduced pressure area to aid in drainage of moisture from the wire.

Hornbostel, Lloyd. Suction press roll arrangement. U. S. patent 2,694,347. Filed Aug. 31, 1950. 9 claims. Assigned to Beloit Iron Works. [Cl. 92-49.] Press felt and paper web are separately guided through the pressure nip so that contact of the web with the felt occurs only at the nip.

Landes, Chester G., and Reynolds, Walter F. Sized waterlaid glass fiber products and process of preparing the same. U. S. patent 2,694,630. Filed May 31, 1952. 10 claims. Assigned to American Cyanamid Co. [Cl. 92–3.] Similar to U. S. patent 2,694,629; paper made predominantly from glass fibers is sized by treatment with an epichlorohydrin-amine condensation product.

Malhiot, Clarence J. Packaging machine. U. S. patent 2,694,350. Filed Nov. 9, 1950. 8 claims. Assigned to F. B. Redington Co. [Cl. 93-53.] Rotary machine for opening collapsed cartons.

Muench, Carl G. Method of saturating fiberboard. U. S. patent 2,694,648. Filed Jan. 31, 1950. 13 claims. Assigned to The Celotex Corp. [Cl. 117-44.] Method of saturating the edges of fiberboard sheets.

Pattilloch, Donald K. Affixing organic and inorganic additaments to cellulosic materials. U. S. patent 2,694,633. Filed Feb. 23, 1950. 10 claims. Assigned to Talbott Development Associates. [Cl. 92-21.] Fibrous materials are first treated with a cationically active, water-insoluble surface-active agent and then an emulsion of a water-insoluble, cationically reactive additament; excellent adsorption is claimed.

Reynolds, Walter F., Jr. Production of sized alkaline paper. U. S. patent 2,694,629. Filed April 18, 1951. 11 claims. Assigned to American Cyanamid Co. [Cl. 92-3.] Sizing of alkaline papers is effected by adding 0.2–5.0% of an epichlorohydrin-amine condensation product to paper stock and then raising the pH.

Richter, George A., and MacLaren, Robert H. Process for preparing wood pulp. U. S. patent 2,694,631. Filed Aug. 31, 1949. 8 claims. Assigned to Eastman Kodak Co. [Cl. 92-11.] Wood pulp with high alpha-cellulose and low pentosan content is prepared by treatment with an aqueous solution of sulphur dioxide and subsequent pulping with sulphate process green liquor.

Shanahan, Curtis M. Bottle carrier with partitions. U. S patent 2,694,504. Filed May 12, 1952. 7 claims. Assigned to Container Corp. of America. [Cl. 220-111.]

Stingle, Sylverius E., and Stingle, Clarence O. Precision core for paper rolls. U. S. patent 2,694,534. Filed Feb. 26, 1952. 1 claim. [Cl. 242-68.] A core for rolls of paper for cash registers or the like is formed from moldable material and provided with reinforcing internal ribs and end walls.

Sundelin, Arne. Machine for manufacture of chips or shavings of wood waste and other wood material. U. S. patent 2,694,531. Filed Jan. 21, 1953. 1 claim. Assigned to Aktiebolaget A. Ekstroms Maskinaffar. [Cl. 241-141.]

White, William A., Jr. Paper machinery. U. S. patent 2,694,344. Filed July 16, 1952. 14 claims. Assigned to The Black-Clawson Co. [Cl. 92-27.] Both plug and shell of a conical refiner are equipped with working and breaker-feeder sections which impel the agitated stock into the main section of the refiner under positive pressure.

Winkler, Richard, and Dunnebiar, Max. Method of and machine for the manufacture of envelopes with gummed closure flaps. U. S. patent 2,694,351. Filed Nov. 14, 1950. 18 claims. Assigned to Berkley Machine Co. [Cl. 93-63.]

Zanck, Gerald J., and Matz, Max W. Box-type container carton. U. S. patent 2,694,518. Filed Feb. 27, 1950. 6 claims. [Cl. 229-15.] A handled container is held by an outer paper band.

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Castellani, Aldo. Continuous plastic waterproof coating in bituminous glass asbestos for buildings and application process thereof. U. S. patent 2,695,257. Filed Dec. 22, 1950. 3 claims. [Cl. 154-128.] Use of felted glass fibers in waterproof roofing compositions.

Compton, Justin S. Process of recording by decoloring. U. S. patent 2,695,245. Filed Jan. 18, 1950. 1 claim. Assigned to The National Cash Register Co. [Cl. 117-15.] Treating an attapulgite-coated paper with crystal violet lactone gives a blue color to the paper surface. Decolorization is effected by printing with a solution of stearyl ammonium chloride.

Covan, Morton. Multiple mailing envelope. U. S. patent 2,695,130. Filed Nov. 14, 1950. 2 claims. [Cl. 229-73.] Envelope construction provides for seven mailings.

Edwards, William A., Jr. Adjusting device for roll coater apparatus. U. S. patent 2,695,003. Filed Nov. 7, 1951. 3 claims. Assigned to Armstrong Cork Co. [Cl. 118-249.] A roll coater includes an applicator roll, a feed roll, with scraper, and an adjusting device for the scraper.

Fountain, Harold. Method and apparatus for continuous printing and flocking. U. S. patent 2,695,244. Filed Dec. 15, 1950. 11 claims. Assigned to United Merchants and Manufacturers, Inc. [Cl. 117-13.]

Hartwig, Walter J. Hydraulic log barker. U. S. patent 2,695,194. Filed Jan. 28, 1950. 9 claims. Assigned to Allis-Chalmers Manufacturing Co. [Cl. 299-62.] A rotary nozzle assembly directs a jet of maximum discharge to the central portion and jets of reduced discharge to the edges of a log or slab.

Lewin, Tobias, and Stratton, Paul L. Apparatus for applying color coatings to sheet material. U. S. patent 2,695,005. Filed Jan. 5, 1953. 3 claims. Assigned to Tobey Color Card Co. [Cl. 118-412.] An apparatus for applying color coatings to produce a multicolored pattern of contiguous stripes on a moving web of paper.

MacDonald, Chester R. Apparatus for the manufacture of waterproofed multiply sheets. U. S. patent 2,694,963. Filed April 8, 1949. 4 claims. Assigned to The Patent and Licensing Corp. [Cl. 92-41.] An emulsion-film applicator apparatus automatically controls the flow of the waterproofing material in response to variations in the speed of the cylinder machine.

Montgomery, William J., and Taylor, William P. Doctor blade for coating machines. U. S. patent 2,695,004. Filed March 2, 1951. 6 claims. Assigned to the Champion Paper and Fibre Co. [Cl. 118-262.] A rotatable rod is enclosed around more than half its circumference in a bearing, leaving a portion of the rod exposed to perform the doctoring operation.

Rendall, Warren C. Shipping container. U. S. patent 2,695,128. Filed Sept. 23, 1949. 1 claim. Assigned to Gaylord Container. Corp. [Cl. 229-52.] Shipping container with handle of the clothing-box type with hinged cover.

Richter, Johan C. F. C. Apparatus for heating and controlling the temperature of a continuously operating cellulose digester. U. S. patent 2,695,232. Filed July 7, 1951. 8 claims. Assigned to Aktiebolaget Kamyr. [Cl. 92-7.] Apparatus for drawing off digesting liquor through a sieve arrangement in the cylinder wall, and returning it to the zone from which it was withdrawn by means of a tube extending down through the top of the digester.

Robinson, Ernest B. Method of producing helically wound containers. U. S. reissue patent 23,899. Filed Aug. 4, 1953. 12 claims. [Cl. 93-94.] Control device regulates cutting of paperboard tubes; reissue of U. S. patent 2,623,445 (Dec. 30, 1952).

Russell, Floyd A. Ice-cream sandwich package. U. S. patent 2,695,126. Filed Oct. 14, 1953. 7 claims. Assigned to Russell Corp. [Cl. 229–14.] Corrugated greaseproof parchment paper is wrapped around exposed ice cream in sandwich.

Short, Charles R., and Short, George E. Decorticating machine and method of treating fiber from ramie and similar fiber-bearing plants. U. S. patent 2,694,832. Filed Dec. 29, 1948. 17 claims. [Cl. 19-10.] The mobile, high-capacity, decorticating machine removes the outer fibrous portion of ramie and similar plants.

Smith, John W. Apparatus for nicking the edge of the web

passing through a wrapping machine. U. S. patent 2,694,964. Filed Sept. 8, 1952. 10 claims. Assigned to Battle Creek Packaging Machines, Inc. [Cl. 93-1.] Apparatus for applying a strip of tear material transversely across a web of wrapping paper and simultaneously nicking the edges of the paper on each side of the tear strip to facilitate easy opening of the wrapper.

Stahmer, Bernhardt. Flexible container support. U. S. patent 2,695,129. Filed June 19, 1952. 4 claims. [Cl. 229-55.] A cardboard cover is stapled to a plastic bag.

Vergobbi, John G. Container-forming machine. U. S. patent 2,694,965. Filed Nov. 9, 1951. 12 claims. Assigned to Pneumatic Scale Corp., Ltd. [Cl. 93-36.01.] Apparatus for forming inner bags or liners from heat-sealable material.

Vergobbi, John G. Container-forming machine. U. S. patent 2,694,966. Filed May 3, 1951. 12 claims. Assigned to Pneumatic Scale Corp., Ltd. [Cl. 93-44.1.] A double-package maker (inner liner and outer carton) forms oversize containers on a standard machine.

Vines, Oscar L. Collapsible carrier for columnar articles and the like. U. S. patent 2,695,116. Filed Oct. 20, 1950. 14 claims. [Cl. 220-113.] Bottle carrier.

Vines, Oscar L. Collapsible carrier for bottles and columnar objects. U. S. patent 2,695,127. Filed March 31, 1949. 2 claims. [Cl. 229-52.]

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Bass, Sam T., Jr., and Hancock, John W., Jr. Machine for coating opposite edges of sheet material. U. S. patent 2,695,591. Filed July 13, 1953. 2 claims. [Cl. 118-224.] The device claimed applies a strip of adhesive coating to both sides of a carbon sheet.

Baxter, Joseph, Jr. Sealing means for cylinder papermaking machines. U. S. patent 2,695,550. Filed March 31, 1951. 1 claim. Assigned to The Black-Clawson Co. [Cl. 92-43.] A sealing ring for the clearance area between the end walls of the cylinder mold and vat is claimed.

Becker, Frederick G. L. Apparatus for disintegrating bales of fibrous materials. U. S. patent 2,695,756. Filed Oct. 24, 1949. 2 claims. Assigned to Cellulose Development Corp., Ltd. [Cl. 241-163.] The machine claimed comprises an outer casing in which a rotor provided with short teeth rips off parts of the bale which are subjected to further rubbing action.

Crosslin, William M. Lifting device for fiberboard and the like having a braced base supported upright. U. S. patent 2,695,759. Filed Feb. 13, 1951. 1 claim. [Cl. 248-46.]

Dixon, Charles H. Dispensing carton with gable top. U. S. patent 2,695,745. Filed Jan. 20, 1950. 1 claim. Assigned to Ex-Cell-O Corp. [Cl. 229-17.] Gabled top of paperboard milk carton forms pouring spout.

Fisher, Guy N. Package. U. S. patent 2,695,847. Filed March 10, 1951. 6 claims. Assigned to Kraft Foods Co. [Cl. 99-172.] Convolutions in wound paperboard tube for prepared dough are locked by pressure formed by leavening gases.

Jaccard, Gaston, and Stockar, Klaus. Composition for combating foam. U. S. patent 2,695,892. Filed Dec. 20, 1949. 4 claims. Assigned to Sandoz Ltd. [Cl. 252-358.] One of several glycerol ethers dissolved in isopropanol or emulsified with water.

Gattuso, Salvatore E. Double-walled container. U. S. patent 2,695,744. Filed Sept. 23, 1952. 2 claims. Assigned 8% to Anthony Capizzi, 8% to Peter Capizzi, 8% to Andrew J. Pantano, and 25% to Joseph Radosti. [Cl. 229-14.] Inner metal-foil cup spaced apart from corrugated board casing.

Pollack, Maxwell A. Tall oil esters with monohydric phenols. U. S. patent 2,695,897. Filed July 21, 1951. 3 claims. [Cl. 260-27.] Modified plastic resins are described in which the modifier consists of an ester of a monohydric phenol with tall oil.

Quinn, Robert G. Asbestos millboard and method of manufacture. U. S. patent 2,695,549. Filed Feb. 17, 1949. 9 claims. Assigned to Johns-Manville Corp. [Cl. 92-39.] Use of amorphous silicic acid as a binder for asbestos millboard improves its wet strength, heat resistance, and dielectric strength.

Rohdin, James O. Packeting machine. U. S. patent 2,695,551. Filed Aug. 31, 1950. 6 claims. Assigned to Esselte Forpackning Ab. [Cl. 93-53.] Gripper mechanism engages flaps to insure complete opening by carton-erecting machine.

Stephens, Joseph F. Fibrous mat. U. S. patent 2,695,855. Filed Nov. 23, 1949. 4 claims. Assigned to Guston-Bacon Manufacturing Co. [Cl. 154-54.] An acoustical and heat-insulating fibrous mat comprises a mixture of organic carrier and filler fibers, resinous binder, and a rubber material.

Tetrault, Philip A., and Stark, Egon. Process for preparing alpha amylase. U. S. patent 2,695,863. Filed April 16, 1952. 14 claims. Assigned to Purdue Research Foundation. [Cl. 195-66.] Alpha-amylase is produced by cultivating the organism *Bacillus stearothermophilus* on a nutrient medium containing starch and at least 2% proteinaceous material.

Toews, Harry I. Apparatus for packaging articles between two continuous sheets. U. S. patent 2,695,483. Filed April 17, 1952. 21 claims. [Cl. 53-32.] Disk-shaped food products are placed between two sheets, which are sealed and cut for delivery.

Tollison, Paul L. Brush arm mechanism for web splicing device. U. S. patent 1,695,758. Filed Sept. 18, 1951. 6 claims. Assigned to Wood Newspaper Machinery Corp. [Cl. 242-58.]

Woodward, Donald E. Tuck-in sleeve. U. S. patent 2,695,746. Filed Nov. 10, 1949. 2 claims. Assigned to Raymond Bag Co. [Cl. 229-62.5.] Tuck-in sleeve reinforces corner of valve-type paper bag.

December 7, 1954

Bateman, Lawrence G. Carton feeding mechanism. U. S. patent 2,696,381. Filed Nov. 16, 1951. 6 claims. Assigned to Delamere & Williams Co., Ltd. [Cl. 271-31.] A stack of cartons is advanced in variable increments proportional to the thickness of one or more of the cartons being withdrawn from the stack.

Baumann, Martin M. Pallet. U. S. patent 2,696,356. Filed Feb. 7, 1952. 2 claims. Assigned to International Paper Co. [Cl. 248-120.] A two-ply supporting platform is formed from corrugated board or the like.

Bergstrom, Harold A. Fiber container with lined opening. U. S. patent 2,696,339. Filed June 15, 1950. 3 claims. Assigned to Continental Can Co., Inc. [Cl. 229-4.5.] A smooth, wide-throated container particularly adaptable to the handling of yarn roving or sliver.

Bergstrom, Harold A. Heavy duty fiber drum for liquids and semiliquids. U. S. patent 2,696,340. Filed Jan. 2, 1951. 1 claim. Assigned to Continental Can Co., Inc. [Cl. 229-5.7.] The liners of the container walls and bottom are pressed with a bead (formed by an interlocked metal chime and tray flange) into a strong liquid-tight seal.

Birchler, Robert O., and Ertner, Edward W. Apparatus for equalizing tension on webs. U. S. patent 2,696,192. Filed Oct. 23, 1952. 9 claims. Assigned to Western Electric Co., Inc. [Cl. 118-34.] Means are provided for taking up slack of baggy portions of a paper web.

Chapman, Ralph. Suction molding machine. U. S. patent 2,696,146. Filed Jan. 18, 1952. 1 claim. Assigned to Chapman Forest Utilization, Inc. [Cl. 92–39.] A device for forming individual mats from a slurry of fiber comprises an endless forming screen which travels between a lower suction box and a vertically reciprocating upper deckle box.

Church, Albert, and Greenlaw, Harold. Carton carrier. U. S. patent 2,696,401. Filed Oct. 15, 1951. 9 claims Assigned to Edlo, Inc. [Cl. 294-87.2.] A cardboard strip may be folded and locked into a carrier for securing a pair of gable-topped milk cartons.

Ellis, Robert S. Process of abrasively buffing a surface of a paper web. U. S. patent 2,696,151. Filed Dec. 12, 1949. 3 claims. Assigned to S. D. Warren Co. [Cl. 92-68.] The buffing composition comprises a finely divided abrasive polyethylene glycol, sufficient water to dissolve at least part of the polyethylene glycol, and a humectant, like glycerin.

Fahrni, Fred. Method and machine for spreading core material. U. S. patent 2,696,330. Filed Jan. 9, 1951. 7 claims. [Cl. 222-196.] Means for spreading, distributing, and depositing wood chips or shavings upon trays in the manufacture of wood-particle board are claimed.

Fahrni, Fred. Method and apparatus for surface material spreading. U. S. patent 2,696,331. Filed Jan. 9, 1951. 5 claims. [Cl. 222-227.] The machine deposits shavings and thin pieces of wood for the manufacture of surface layers of composite wood-particle board.

Fischer, Paul E. Method and apparatus for sealing cartons. U. S. patent 2,696,245. Filed Dec. 23, 1950. 17 claims. Assigned to General Mills, Inc. [Cl. 154-42.] Cartons whose side walls lack rigidity are inverted, so that the weight of carton and its contents force the closing elements into sealing contact.

Gilbert, Clyde L. Bottle carrier. U. S. patent, 2,696,341. Filed Aug. 25, 1949. 2 claims. Assigned to Robert Gair Co., Inc. [Cl. 229-28.]

Heywood, Vincent E. Blank-forming method and mechanism for envelope making machines. U. S. patent 2,696,255. Filed July 2, 1948. 19 claims. Assigned to United States Envelope Co. [Cl. 164–61.]

Hogan, William J. Apparatus for handling box parts between sequential stapling operations. U. S. patent 2,695,998. Filed Aug. 6, 1952. 2 claims. Assigned to Stapling Machines Co. [Cl. 1-8.1.] Units are mechanically conveyed between a first and second bank of staplers.

Hornbostel, Lloyd. Combined fluid pressure and suction press. U. S. patent 2,696,148. Filed Jan. 7, 1950. 7 claims. Assigned to Beloit Iron Works. [Cl. 92-49.] The suction roll is provided with a resilient cover which forms a fluid seal at the press nip.

Hornbostel, Lloyd. Paper machine suction press. U. S. patent 2,696,149. Filed Jan. 11, 1950. 2 claims. Assigned to Beloit Iron Works. [Cl. 92-490.] A reverse suction press with a

vertical nip and clean transfer by utilization of gravitational forces to strip the web from the reverse press felt is claimed.

Jackson, Patrick T., Jr. Web reinforcing method and apparatus. U. S. patent 2,696,244. Filed Jan. 24, 1952. 10 claims. Assigned to American Sisalkraft Corp. [Cl. 154-1.76.] Fibers are deposited transversely on a moving web at an angle relative to the web axis by adjusting the speeds of advance of web and fiber supply.

Reyna, Carl A., and Cavalli, Louis W. Carton carrier. U. S. patent 2,696,400. Filed March 27, 1951. 3 claims. Assigned to Edlo Inc. [Cl. 294-87.2.] A carrier for two quart-size milk cartons to be carried in side-by-side relationship.

Schoeffel, Eugene W. Preparation of calcium bisulphite cooking acid from waste sulphite liquor. U. S. patent 2,696,424. Filed June 16, 1951. 4 claims. Assigned to Sterling Drug, Inc. [Cl. 23-131.] A regeneration process for spent calcium bisulphite liquor involves a sequence of operating steps without previous evaporation or concentration, in which the spent liquor is oxidized in liquid phase to yield a calcium sulphate residue which can be roasted to calcium oxide and sulphur dioxide. An aqueous suspension of the calcium oxide is reacted with the evolved sulphur dioxide gas to produce fresh calcium bisulphate cooking acid.

Temperley, John. Wound board machine. U. S. patent 2,696-150. Filed May 31, 1950. 3 claims. Assigned to Walmsleys (Bury) Ltd. [Cl. 92-67.] A make-up roll with a toothed blade recessed in a groove in a wet-lap board machine will cut the sheet during rotation and at high linear velocity.

Trepp, Samuel G. Floor or wall covering or the like and method of manufacturing same. U. S. patent 2,696,452. Filed June 29, 1950. 7 claims. Assigned to Bird & Son, Inc. [Cl. 154-95.] A transparent thermoplastic vinyl film is adhesively bonded (decorated-side-down) to a flexible backing of asphalt-saturated felt.

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Bily, Peter J. Liquid handling machine for log debarking. U. S. patent 2,697,006. Filed Feb. 19, 1951. 6 claims. Assigned to Chiksan Co. [Cl. 299-55.]

Bower, Fred C. Embossing apparatus for web material. U. S. patent 2,696,638. Filed July 21, 1951. 9 claims. Assigned to The Black-Clawson Co. [Cl. 18-10.] A plurality of die rolls with associated guide rolls permit pattern changes on the moving web.

Ervin, Evander M. Packaging machine. U. S. patent, 2,696, 778. Filed May 22, 1950. 13 claims. [Cl. 100-27.] The sequential operations of supplying, dispensing, and wrapping binder tape around a carton or a number of separate objects are controlled by a rotating drum which governs the operation of the power supply.

Heritage, Clark C. Thermosetting molding compounds comprising bark components. U. S. patent 2,697,081. Filed Oct. 24, 1952. 7 claims. Assigned to Weyerhaeuser Timber Co. [Cl. 260-17.2.] A thermosetting molding composition of selected Douglas-fir bark components and phenol-formaldehyde resin is claimed.

Heritage, Clark C. Use of cork as a flow modifier in thermosetting phenol-formaldehyde molding compounds containing the bast fiber of bark. U. S. patent 2,697,082. Filed Oct. 24, 1952. 2 claims. Assigned to Weyerhaeuser Timber Co. [Cl. 269-17.2.]

Heritage, Clark C. Molding compounds comprising alkaline earth metal oxide and borax as sticking and staining preventives. U. S. patent 2,697,083. Filed Oct. 24, 1952. 5 claims. Assigned to Weyerhaeuser Timber Co. [Cl. 260-17.2.]

Kellerer, Marylka B. Three-dimensional greeting card. U. S. patent 2,696,690. Filed May 28, 1951. 3 claims. [Cl. 41-11.] A process whereby cards may be produced on the printing press and/or stamping die in one operation.

Lindenfelser, Richard, and Kilthau, Martha K. Modified melamine-formaldehyde resin and process of preparing the same. U. S. patent 2,697,086. Filed March 18, 1952. 11 claims. Assigned to American Cyanamid Co. [Cl. 260-29.4.] A stable sirup of melamine, formaldehyde, and polyvinyl butyral is suitable for the preparation of craze-resistant laminate surfaces.

Lovekin, Louise G. Disposable diaper. U. S. patent 2,696,819. Filed Dec. 30, 1952. 9 claims. [Cl. 128-284.]

McNeill, Robert. Beating engine for paper pulp. U. S. patent 2,696,767. Filed June 15, 1951. 12 claims. Assigned to McNeill Winterburn Inventions Ltd. [Cl. 92-22.] The productivity rate of the beater is increased by periodically intercepting the flow of pulp at the top of the backfall, causing the pulp to pass over the roll repeatedly, and shooting it over the backfall between the intervals of interception.

Malhiot, Clarence J. Agitating mechanism for carton filling machines. U. S. patent 2,696,941. Filed Oct. 7, 1950. 13 claims. Assigned to F. B. Redington Co. [Cl. 226-95.]

Martin, William T. Article wrapping machine. U. S. patent 2,696,702. Filed Jan. 29, 1953. 2 claims. Assigned to Beech-Nut Packing Co. [Cl. 53-131.] Pieces of chewing gum or the like are wrapped in waxed paper, heat sealed, and conveyed for placement in cartons.

Mickey, Arthur C., McMillan, Archie, and Beeker, Bernie. Bellows folding machine. U. S. patent 2,696,768. Filed Sept. 12, 1949. 36 claims. Assigned to General Motors Corp. [Cl. 93-1.] A paper tube is formed into alternately pleated bellows by means of former's cooperating with movable fingers.

Oberem, William C. Control system for box blank forming machines. U. S. patent 2,696,769. Filed Nov. 20, 1951. 16 claims. Assigned to Colt's Manufacturing Co. [Cl. 93-58.]

Rickus, George M. Box making machine. U. S. patent 2,696,612. Filed Aug. 8, 1951. 14 claims. Assigned to Hat Corporation of America. [Cl. 1-11.] Octagonal hat boxes are assembled without use of glue or cement.

Ringler, William A. Collapsible bottle carrier. U. S. patent 2,696,942. Filed May 10, 1952. 11 claims. Assigned to The Gardner Board & Carton Co. [Cl. 229-28.] The paperboard blanks can be scored and cut from stock sheets previously finished, imprinted, and decorated on one side only.

Sandberg, Nels H. Digester filling chute. U. S. patent 2,696,-904. Filed Nov. 18, 1950. 4 claims. Assigned to Waldorf Paper Products Co. [Cl. 198-52.] Chips are scattered mechanically in the digester by means of a rotatable paddle wheel attached to the movable chute.

Stark, Donald L. Paper machinery. U. S. patent 2,696,766. Filed Aug. 21, 1952. 12 claims. Assigned to The Black-Clawson Co. [Cl. 92-20.] A pulper for handling the full output of broke during a web break on a paper machine will operate with equal effectiveness over a considerable range of depths of stock in a tub.

Stevens, Louis M. Container construction. U. S. patent 2,696,943. Filed June 16, 1952. 1 claim. Assigned to Camden Bag and Paper Co. [Cl. 229-43.] A milk carton with a central top opening adaptable for use by existing glass-bottle filling mechanisms is furnished with a separate pouring spout near the edge.

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Arneson, Edwin L. Article carrier. U. S. reissue patent 23,-912. Filed June 3, 1953. 6 claims. Assigned to Morris Paper Mills. [Cl. 220-111.] Additional reinforcing means for a one-piece paperboard bottle carrier are claimed in a reissue of U. S. patent 2,634,043 (April 7, 1953).

Bergstein, Robert M. Container incorporating nonfibrous films. U. S. patent 2,697,546. Filed June 9, 1948. 4 claims. Assigned to the Bergstein Packaging Trust. [Cl. 229-34.] Collapsible box is cellophane covered by a mode of manufacture requiring only the standard box-factory equipment.

Charlton, Edward J., and Pompa, Leonard. Double shell drier roll construction. U. S. patent 2,697,284. Filed Sept. 1, 1950. 7 claims. Assigned to Lukens Steel Co. [Cl. 34-124.] A rugged hub structure for drier drums includes elements welded to each other, to the journals, and to the drum walls.

Durkee, Clarence L. Wood chipper. U. S. patent 2,697,557. Filed March 17, 1952. 7 claims. Assigned to D. J. Murray Manufacturing Co. [Cl. 241-92.] A multi-knife rotary chipper and feed-spout assembly handles logs of various diameters and shapes, including abnormal logs, without jamming.

Elmendorf, Armin. Embedded fiber wallboard. U. S. patent 2,697,677. Filed March 12, 1952. 6 claims. [Cl. 154-45.9.] In a matrix of gypsum and cement are embedded short strandlike wood fibers; in the surface zones the binder exceeds the fiber volume and in the core the opposite takes place.

Gordon, Bruce A. Dry process of manufacturing pressboard. U. S. patent 2,697,254. Filed March 14, 1950. 3 claims. [Cl. 18-47.5.] Progressive pressure, concurrent with high frequency oscillations, is applied to fiberized wood waste which has been reduced to a predetermined moisture content and mixed with a binder.

Heritage, Clark C., and Van Beckum, William G. Fractionation of lignocellulose materials. U. S. patent 2,697,701. Filed Feb. 9, 1951. 23 claims. Assigned 50% to Weyerhaeuser Timber Co. and 50% to Wood Conversion Co. [Cl. 260-124.] A pulping process is described in which lignin and polysaccharides are removed from wood by treatment with caustic, hypochlorite, and caustic. Details are given for recovery of extracts.

Heritage, Clark C., and Van Beckum, William G. Fractionation of lignocellulose materials—CHC steps. U. S. patent 2,697,702. Filed Feb. 9, 1951. 19 claims. Assigned 50% to Weyerhaeuser Timber Co. and 50% to Wood Conversion Co. [Cl. 260-124.] Continuation of U. S. patent 2,697,701. Papermaking quality of resulting pulp is discussed.

Heritage, Clark C., and Van Beckum, William G. Fractionation of lignocellulose materials. U. S. patent 2,697,702. Filed

Feb. 9, 1951. 19 claims. Assigned 50% to Weyerhaeuser Timber Co. and 50% to Wood Conversion Co. [Cl. 260-124.] Comminuted wood fiber is water extracted and then treated with sodium hypochlorite to remove lignin.

Hollis, Robert F. Digestion of pulp. U. S. patent 2,697,661. Filed July 31, 1946. 2 claims. Assigned to Alton Box Board Co. [Cl. 92-1.4.] Waste paper containing asphaltic or similar contaminants is treated under heat and pressure by a continuous process to disperse the contaminants as fine specks.

Kurth, Ervin F. Process of beneficiating Douglas fir wax and product thereof. U. S. patent 2,697,717. Filed July 2, 1951. 33 claims. Assigned to State of Oregon, acting by and through the Oregon State Board of Forestry. [Cl. 260-424.] Extracted Douglas-fir wax is bleached with a mineral acid and then treated with a base-metal oxide. The resultant wax is improved with respect to color, hardness, and melting point.

Lane, Clifford J. Mandrel. U. S. patent 2,697,386. Filed May 6, 1949. 3 claims. Assigned to Daystrom, Inc. [Cl. 93-81.] A floating-mandrel construction for forming tubes from sheet material prevents misalignment and jamming.

MacIntire, Walter H. Treatment of alkaline waste waters. U. S. patent 2,697,658. Filed May 5, 1950. 4 claims. Assigned to the University of Tennessee Research Corp. [Cl. 71-25.] Calcium chloride and orthophosphoric acid are added to spent alkaline liquors to form dibasic calcium phosphate and to coprecipitate said calcium phosphate and organic matter. The liquor is clarified by usual means and the dried precipitate used as fertilizer or cattle-feed supplement.

MacIntire, Walter H. Treatment of alkaline waste waters. U. S. patent 2,697,659. Filed May 5, 1950. 7 claims. Assigned to the University of Tennessee Research Corp. [Cl. 71-25.] This is similar to U. S. patent 2,697,658 (Dec. 21, 1954); standard superphosphate is substituted for the orthophosphoric acid.

Masterman, Frederick E. Method of coating paper with clay compositions. U. S. patent 2,697,669. Filed Jan. 11, 1951. 1 claim. Assigned to Provincial Paper, Ltd. [Cl. 117-63.] The coating is applied in two layers to reduce the amount of adhesive and produce excellent finish and water-resisting properties.

Morand, Emil. Plural compartment box formed from a single blank of sheet material. U. S. patent 2,697,544. Filed June 21. 1951. 1 claim. [Cl. 229-15.]

Novak, Izador J. Wire insulation. U. S. patent 2,697,740. Filed April 2, 1949. 5 claims. Assigned to Raybestos-Manhattan, Inc. [Cl. 174-110.] A colloidal dispersion of asbestos fibers and an elastomeric binder form a flexible insulating layer for an electrical conductor.

O'Neil, John G. Container-forming apparatus. U. S. patent 2,697,385. Filed June 7, 1952. 14 claims. Assigned to Weinon Corp. [Cl. 93-77.] Flexible paper or cardboard sheets are wrapped around cylindrical mandrels on a rotatable table in synchronism with the movement of the table.

Radin, Edwin F. Pilferage inhibiting shipping container. U. S. patent 2,697,545. Filed Aug. 27, 1948. 5 claims. Assigned to Victory Container Corp. [Cl. 229-23.] A paperboard container has closing end flaps so organized as to intercept the hand reaching for the contents.

Stempel, Laszlo M. Paper-cutting machine. U. S. patent 2,697,488. Filed April 16, 1946. 7 claims. [Cl. 164-43.] A traveling web of flat strip material is cut into several sheets in a continuous operation.

Van Oudenaren, Peter. Stacking of printed sheets. U. S. patent 2,697,602. Filed Jan. 2, 1951. 1 claim. Assigned to Lont and Overkamp Publishing Co., Inc. [Cl. 271-89.] Large paper sheets are delivered curl-free from press to stacking table with the aid of props under the forward corners of the sheet.

Wagonseller, Earl A. Multiple compartment tray. U. S. patent 2,697,547. Filed April 12, 1954. 8 claims. Assigned to Container Corporation of America. [Cl. 229-42.] A tray formed from a single blank is inserted in a transparent wrapper or bag.

Wilcox, Isaac L. Method of making, filling and sealing sterile containers formed of fibrous material. U. S. patent 2,697,313. Filed Oct. 8, 1947. 4 claims. Assigned to Oswego Falls Corp. [Cl. 53-10.] The method applies particularly to paper milk bottles claimed in U. S. patent 2,470,984 (May 24, 1949).

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Ahlmeyer, Heinz, and Sherman, Whitney D. Machine for making hatboxes and the like from flat-folded blanks. U. S. patent 2,697,696. Filed July 13, 1953. 6 claims. Assigned to Robert Gair Co., Inc. [Cl. 93-55.1.]

Belsinger, Jack R. Heavy-duty fiber bottle container. U. S. patent 2,698,126. Filed Feb. 21, 1951. 1 claim. Assigned to Belsinger, Inc. [Cl. 229-34.]

Chaplin, Merle P. Pulp article transfer and reshaping machine. U. S. patent 2,697,967. Filed Jan. 17, 1950. 8 claims. Assigned to Chaplin Corp. [Cl. 92–59.] An apparatus for providing molded pulp articles with integral reinforcing thickened edges.

Clark, James d'A. Production of thick, laminated fibrous structures. U. S. patent 2,698,271. Filed Aug. 13, 1949. 8 claims. Assigned to A. B. Dick Co. [Cl. 154-101.] A dry felting unit comprises a circulating air system with a break, through which is passed, an endless forminous felting surface.

Cote, Omer E., and Nilsen, George H. Machine for making setup boxes. U. S. patents. 2,697,968. Filed March 8, 1952. 20 claims. Assigned to United States Automatic Box Machinery Co., Inc. [Cl. 93-51.] Machine and method for making a six-point setup box.

Fisher, Guy N. Cheese packaging. U. S. patent 2,698,249. Filed Sept. 13, 1949. 1 claim. Assigned to Kraft Foods Co. [Cl. 99-178.] A block of natural cheese is wrapped in a plastic sheet and placed in a laminated fiberboard carton during pressure curing.

Heritage, Clark C. Adhesive or molding composition comprising brown rotted wood and phenol-formaldehyde resin. U. S. patent 2,698,307. Filed Nov. 18, 1949. 3 claims. Assigned to Weyerhaeuser Timber Co. [Cl. 260-17.2.]

Hilborn, Leo B. Bark-removing machine having simultaneously swingable frames supporting cutters and log-rotating wheel. U. S. patent 2,698,036. Filed April 3. 1952. 7 claims. [Cl. 144-208.]

Hines, John E. Shipping and service container. U. S. patent 2,698,124. Filed May 29, 1951. 1 claim. [Cl. 229-7.] A sturdy shipping container construction for carrying 30 or more pounds of small metal parts.

Hyman, Howard D. Paper refiner. U. S. patent 2,697,966. Filed Oct. 22, 1951. 4 claims. Assigned to the Alexander Fleck, Ltd. [Cl. 92-22.] The rotor is rotated either in the direction toward which the blades are inclined (to act as a jordan) or in the opposite direction (to act as a refiner).

Lewis, Harry F., and Buchanan, Marion A. Redwood bark cooking process and resulting products. U. S. patent 2,698,233. Filed Sept. 7, 1949. 5 claims. Assigned to the Pacific Lumber Co. [Cl. 92-3.] Redwood bark digested in aqueous sodium sulphite at 90–170°C. is suitable for the manufacture of insulation board.

Magnani, Alessandro. Apparatus for handling sheets. U. S. patent 2,698,097. Filed Jan. 7, 1949. 7 claims. Assigned to F. L. Smidth & Co. A/S. [Cl. 214-1.] Fibrous cement sheets in plastic condition are kept from sticking to conveyor tables by an air film blown through surface holes in the tables.

Matthews, Merton L. Feeding and stacking machine. U. S. patent 2,698,176. Filed March 17, 1952. 3 claims. Assigned to Maxson Automatic Machinery Co. [Cl. 271-89.] Side-jogging blades prevent the paper sheets from slipping while they are jogged along the auxiliary support which aligns them.

Rowell, George S. Sheet feeding mechanism. U. S. patent 2,698,175. Filed June 8, 1948. 14 claims. Assigned to The Chandler & Price Co. [Cl. 271-11.] A tiltable suction device seizes and advances the topmost sheet of a stack.

Seaman, Stewart E. Acid sulphite pulping. U. S. patent 2,698,234. Filed Oct. 25, 1951. 3 claims. [Cl. 92-11.] After impregnation of chips with liquor with approximately 2% of bisulphite and 3% of sulphurous acid (both expressed as sulphur dioxide) and under hydraulic pressure, all free liquor is withdrawn, steam admitted, and a vapor temperature of 170°C. maintained for one hour until the chips are cooked.

Svanoe, Hans. Sulphite waste disposal. U. S. patent 2,698,-225. Filed Feb. 10, 1951. 7 claims. [Cl. 23-301.] The liquor is circulated in a closed cycle through heating, vaporization, and desupersaturation zones; scale formation is inhibited by maintaining calcium sulphate crystals in the solution during evaporation.

Tipper, Maynard J. G. Apparatus for pleating of casings and similar articles. U. S. patent 2,697,970. Filed Aug. 9, 1952. 1 claim. Assigned 50% to Albert O. Steckman. [Cl. 93-84.]

Thwaites, Herman L., and Hitchcox, Harold F. Paper coating wax. U. S. patent 2,698,309. Filed April 16, 1952. 7 claims. Assigned to Standard Oil Development Co. [Cl. 260-28.5.] A mixture of paraffin wax, polyethylene, and a low-molecular weight polyethylene containing a terminal hydroxyl group.

Trosset, Stanely W., Jr., Fisher, Harry C., and Holmes, Simeon R. Manufacture of water finished board having an insolubilized protein-mineral coating thereon. U. S. patent 2,698,259. Filed May 27, 1950. 11 claims. Assigned to The Gardner Board and Carton Co. [Cl. 117-60.] The surface of the web is first plasticized, coated with a thin layer of mineral coating substances and a casein binder, dried, and calendered with the simultaneous application of an insolubilizing agent.

Vizcarrondo, Gilbert, and Rabby, Joseph G. Container. U. S. patent 2,698,125. Filed June 18, 1953. 15 claims. Assigned to National Container Corp. [Cl. 229-27.] A partitioned shipping container for fresh vegetables is provided with multi-ply walls and cover panels engaging with handles provided on the partition panels.

Quality Control Rates Raw Materials Suppliers

W. A. MAC CREHAN

In today's competitive market the converter cannot afford to be unconcerned for the level of quality of the raw materials flowing into his finishing operation. Every excessive variation entering the receiving door is a potential problem in the finished converting operation. Let us review some case examples to illustrate variation of raw material. Figure 1 is a photograph of loose top liner being pulled off on the rolls of a litho press. Unusual? Not as much as you might at first suspect. Many solid color jobs are plagued with spots due to foreign material pulling from the surface of the board caused by the tack of the ink. Increased demand for gloss calls for a high tack ink. We must, therefore, build into the board surface raw material characteristics that will be equal to the tack pull of modern gloss inks.

Now that we have seen a liner problem, let us look at a moisture variation problem. Figure 2 shows variance from skid to skid. As this paper "conditions" in the plant prior to use, any excessive variation in the mill process from skid to skid is readily apparent by the warp or wrinkle in the top sheets. In the case where a lot comes from the mill directly to the press, this variation causes misregister on multipress operation and cutting misregister with printing on single print operations.

We have seen two cases of variation, first, surface bond of top liner and second, moisture variation. Let us look at a third sample, sheet size.

The usual way to print is with the long length across the cylinder. This means that the "chop" from the roll will govern the fit to the side guide. The ingenious side guide trip is built to shut down a press when a sheet does not feed tight to the guide. This is necessary to prevent batters (Fig. 3). Nothing is more irritating to a pressman than to have variations in cut-off length trip off a press time and again. With these three examples of variation in mind, we now approach the problem of raw material control. It is clear that to inspect every shipment of incoming material for every characteristic would require more inspectors than pressmen!

Where should control start? The answer is. . .where the most good can be done for the least cost. To best determine this, a fault tally can be kept in the press-room for a base period. Usually, a 3-month period is sufficient (Fig. 4). This factual tally usually results in the dispelling of some pet theories that have grown like old wives' tales.

After the tally is completed, a meeting should be held, with the key people affected by pressroom troubles (sales, production, cost, inspection, purchasing, and management) present. This group should determine the factors to be controlled. A pie chart (Fig. 5) will assist in weighing these factors. "Dollars lost" is a good common media as a base.

The next step is to hold, at management level, a series of meetings with the main suppliers. The "approach" in these meetings should be one which encourages an attitude of common interest in—and joint efforts toward the solution of the problems. Realistic specifications should be stressed. . .specifications that can and have been met in the trade. Key people should be selected from the suppliers' staffs as contacts to work with quality control during the study period of the control program.

A control over incoming material is then established for the characteristics chosen as being critical. These will, in most cases, be—in order of their importance: (1) moisture content, (2) surface finish (pick and absorbency), (3) caliper variation, and (4) sheet size. Many others will enter the picture, but surprisingly enough, their dollar cost generally will cancel out their importance.

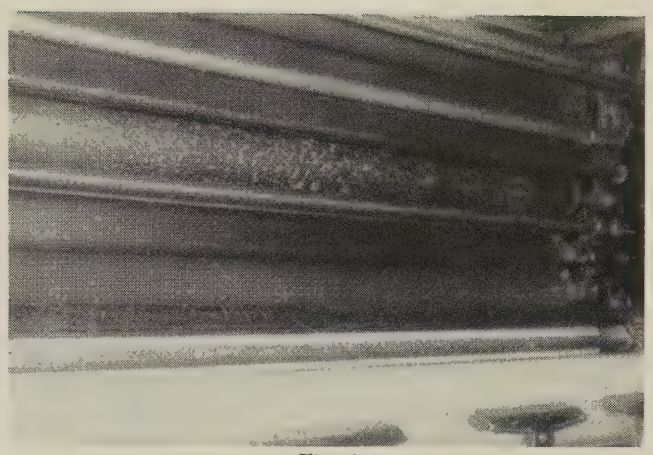

Fig. 1

It is necessary first to work closely with purchasing to find out the specific suppliers for various kinds of boxboard entering the conversion plant. Data forms similar to that shown in Fig. 6 can be used to log in this record. When these have been taken, a decision must be made as to the proper methods for measuring characteristics. The following tests serve very well in practical use:

1. *Moisture.* Hart Moisture Meter with spatular blades for insertion into the skid while still banded is used. Cross check with oven test periodically for calibration.

2. *Surface Finish.*

(a) Pick Testing. On calendar formed board, pick waxes are indicative, but not positive. On coated board, ink coated rolls pressed on with pressure and rolled off with a snap motion using shaded pattern engravings or plates can indicate coating adherence strength.

(b) Absorbancy tests depend mainly on the source of the boxboard. Some mills use K & N ink with a Photovolt unit, others use butyl, oil, and latex dilutions. At present, for an all-purpose test of both uncoated and coated boards, the ink smear with a reflectance reading is most widely used. Here, it must be remembered that each mill has its own peculiarities of process; range of variation will differ from mill to mill, consequently, the data should be compared within the limits of a given mill reading.

3. *Caliper variation* can be measured accurately either by a spring-loaded caliper or a gravity drop caliper. On multiple layer construction boxboard the two types of calipers will give interchangeable readings.

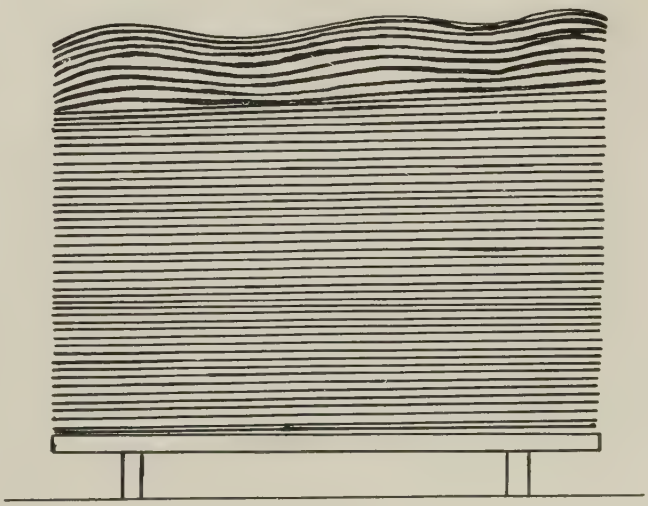

Fig. 2

W. A. MacCrehan, Quality Engineer, Bendix Radio, Towson, Md.

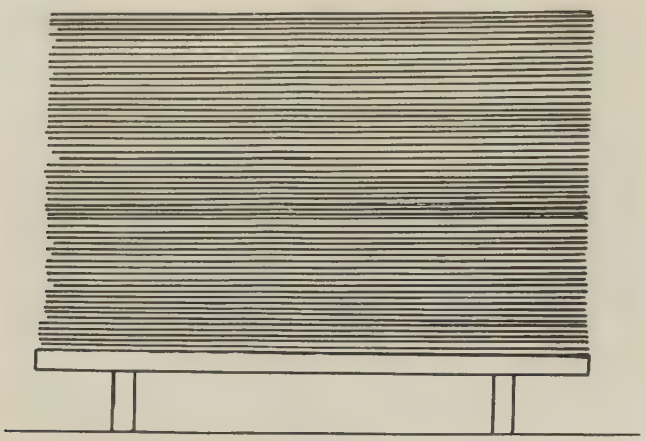

Fig. 3

4. *Sheet size* can best be measured by constructing a flat table with two adjacent right angle measuring scales. The sheet should have "cut off" on one reference and "trim" at the other. This device will indicate bias cuts as well as variation in dimension. With the increasing swing toward lithography, dimensioning at the mill becomes more important to assist in controlling register between cylinders and between presses.

At this point, it should be clearly recognized that the ability to measure boxboard qualities to the accuracy of metal work is still to be attained; thus "common sense" judgment will qualify many test values. This variable of complete control of measurements should be thoroughly understood by both the mill involved and the converter applying conclusions from the measured data.

With the above background, let us now see an example of raw material control in action.

A major problem of a coated board supplier was variation in moisture. Generally, this was not excessive in range, but, because of its lack in uniformity, caused press variation on a five-color job that ran once through a four-color press and once through a two-color press. The combination of colors ran three down on first operation and two down on second operation. The finished copy called for tight register. This meant that any major change in dimension between the first operation and the second operation would greatly reduce the yield as misregister on this copy caused immediate rejection of the finished product.

Because of production cycles, it was impossible to foresee customer needs, thus warehousing of the raw stock was impractical. The variance between atmospheric conditions in the warehouse and pressroom may offset any gain by partial conditioning.

Mar. 1-6-53 — Press Fault Study

Work Order	Vendor	Faults	Action	Foreman DB Lost Time	Sup'r C I W Press Rate	a.c. wash. Total
53-506	B	Wet Stock	Wind sheets	2½	11.35	27.38
53-524	A	Wrinkled	sort at delivery	¾	12.17	9.13
53-546	B	Cut off short	sort at feeder	Split cost 2	11.65	11.65
53-561	C	Uneven coating	change ink	2	12.17	24.34
53-574	A	Stock wet on bottom layers	Repile	4	11.65	46.60
53-582	A	hickies	change ink	3	11.35	34.05

Fig. 4

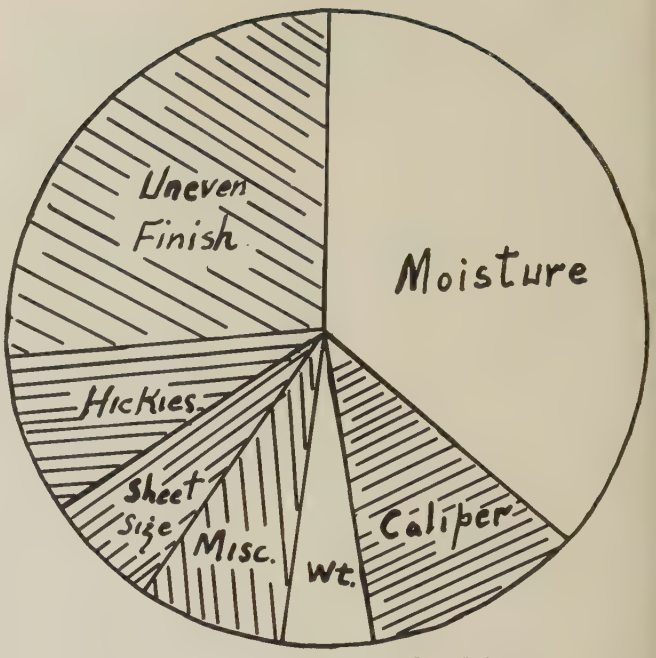

Fig. 5. Actual pressroom breakdown

A study was made by measuring each skid in four places as received. This was accomplished by inserting spatular blades into the bound skid. Correlation within ±1/2% was obtained with flat sheet clamp readings by the meter and within ±3/4% on oven checks. Figure 7 shows the data recorded. The skid number record is valuable to the mill so that production sequence and position on "trim cut" can be obtained.

After these data were plotted on control charts it became clear that mill production followed a cycle. With the segregation of skids into numerical groups (Fig. 8), it was possible to minimize the present problem, but not to solve the basic, long-range problem. The mill representatives designated as "control conferees" were called in and the data analyzed. It was decided that periodic checks at the mill using portable moisture meter readings would supplement their oven test. When the next run was made, similar data were plotted (Fig. 9).

The variance was narrowed to show better uniformity from skid to skid. This lot still had some extremes and scheduling of skid order to the press was done to again minimize extreme differences of moisture. A tight cycle was established be

Date 5 Feb. — Raw Material Control Check

Requisition	Type	Test	OK	Rej	Skid	Insp	Moisture	Ash-Dens	Surface	Caliper	Sheet Dim
OB 123-53	W.P.C.N.	2½ AQL			1	M.K.	6.6 6.1 6.2	24 24 24	3/0	19 18 19	OK
"	"	"			2	M.K.	6.1 6.5 6.2	13 13 14	3/0	19 18 19	OK
"	"	"			3	M.K.	6.6 6.7 6.1	13 13 14	3/0	18 19 18	OK
"	"	"			4	M.K.	6.7 6.3 6.5	14 13 13	3/0	18 18 19	OK
"	"	"			5	M.K.	6.2 6.5 6.6	14 14 13	3/0	18 19 19	OK
OB 29-53	B.M.L.C.	2½ AQL			1	J.W.	6.0 6.1 Bal	12 11 11	3/0	20 21 20	OK
"	"	"			2	J.W.	6.2 5.9 6.1	11 11 12	3/0	21 21 20	OK
"	"	"			3	J.W.	6.5 6.3 6.3	11 12 11	3/0	20 21 20	OK

Fig. 6

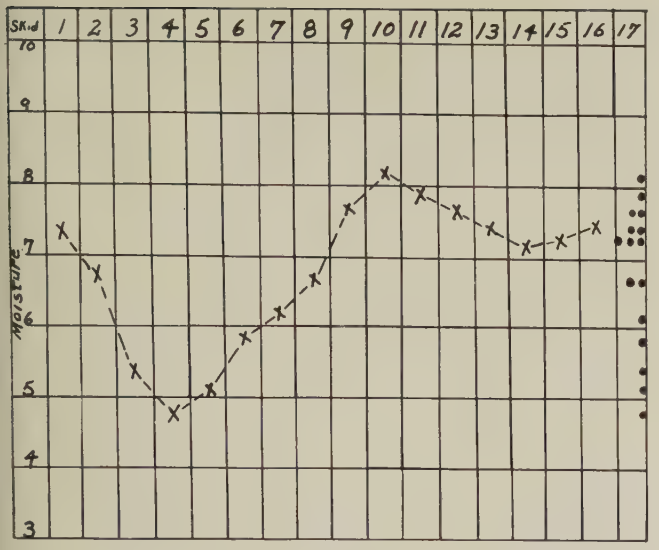

Fig. 7

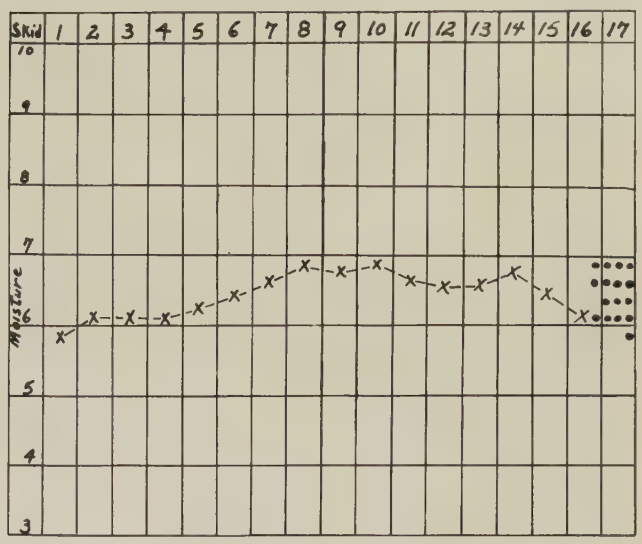

Fig. 9

tween first and second operations to attempt to maintain moisture equilibrium between presses.

With the control experience of two runs behind them, the mill's "control conferees," were able to institute further controls during the mill process. A third run (Fig. 10) showed very good uniformity, enabling the conversion plant to run the skids at the press in any order convenient to their material handling group. This, in itself, was a major accomplishment, since few conversion plants are designed for first in-first out material controls.

With moisture control established, maintaining register was strictly a matter of pressroom skill.

In this instance, the run was for 2 million cartons with a past record of 5.8% spoilage. Using controlled raw material, three successive runs tallied 3.4%, 2.9%, 3.1%. In terms of a five-color carton selling for $68.70 per thousand, this was an appreciable saving; however, the real gain came from the indisputable fact that the knowledge of control exercised on the lots of raw material involved in this study by the mill would be incorporated into other lots of raw material produced by this vendor.

In a similar manner, key problems on surface finish, caliper variation, sheet size, etc., were worked out by this four-step control:

1. Knowing the *real* problem by getting pressroom facts, not pressroom opinions.
2. Getting together with the vendors to advise them of your quality drive.

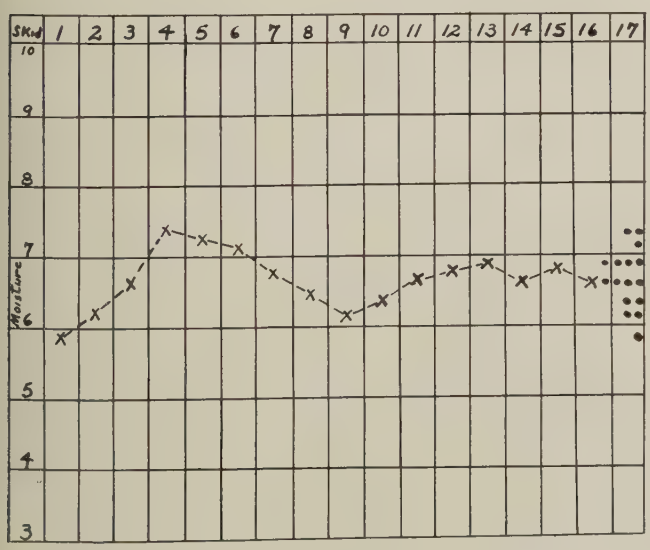

Fig. 8

3. Recognizing that papermaking is an art that is slowly becoming a science through measured controls of variation.
4. Sticking to basic problems, seeing these through instead of blanketing the pressroom problems and weakening the attack.

This control of raw material by graphic statistical methods can and will build finer products. Three points are vital: first, common sense in working out problems with the supplier; second, objectivity in management decisions, and finally, selling the program thoroughly within the organization before dealing with outside vendors. These factors provide a key for better conversion of paper products through better controlled raw materials.

Presented at the 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 18–21, 1954.

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NATIONAL MEETINGS

Sixth Coating Conference, Statler Hotel, Cleveland, Ohio, May 23–25, 1955.

Fourth Statistics Summer Course, Forest Products Laboratory, Madison, Wis., July 10–23, 1955.

Fifth Fundamental Research Conference, Institute of Paper Chemistry, Appleton, Wis., September 15–17, 1955.

Second Mechanical Pulping Conference, Poland Spring House, Poland Spring, Me., September 19–21, 1955.

Fifth Corrugated Containers Conference, Morrison Hotel, Chicago, Ill., October 5–7, 1955.

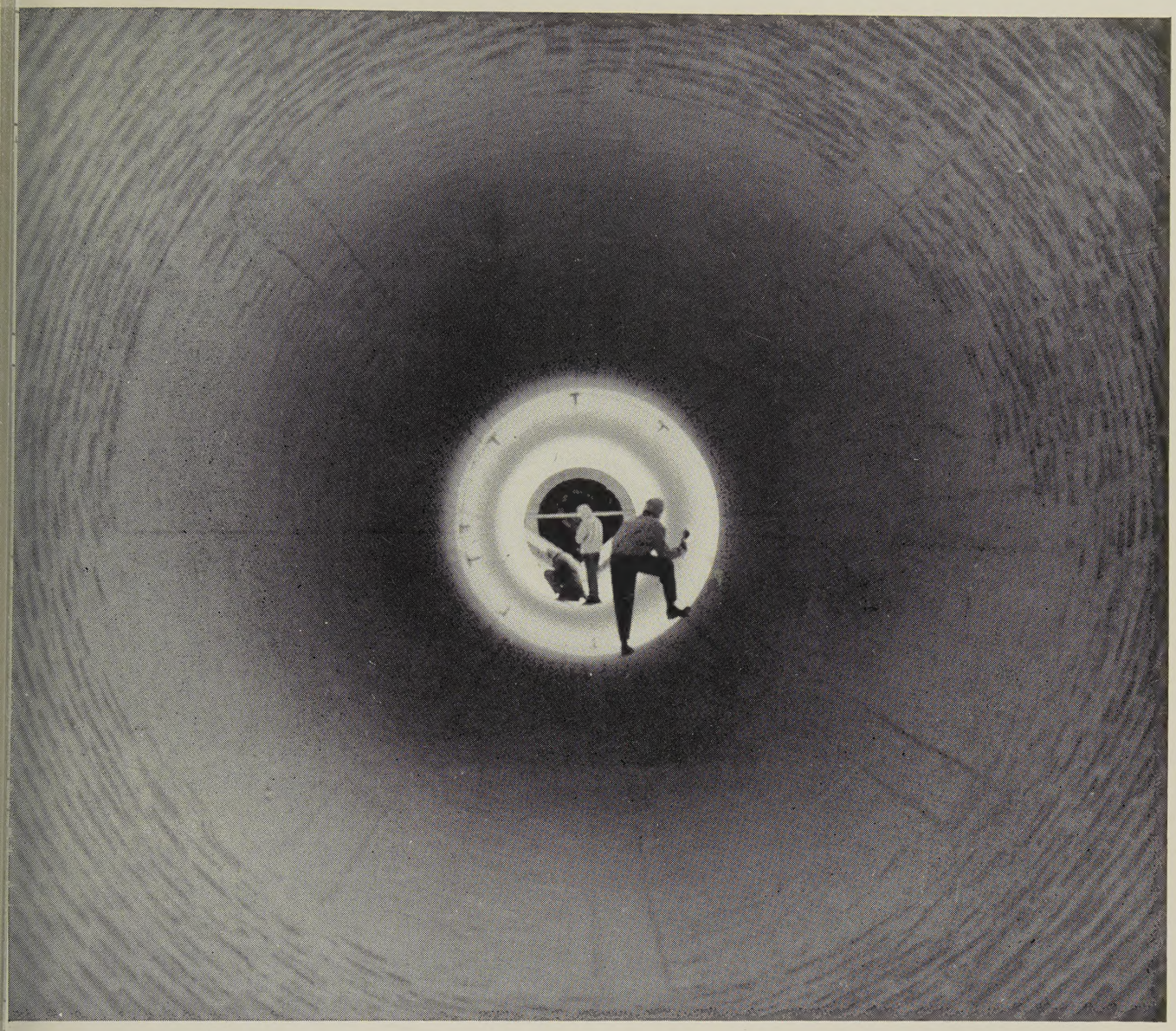
Fifth Testing Conference, Hotel Sheraton-Kimball, Springfield Mass., September 28–30, 1955.

Ninth Alkaline Pulping Conference, Hotel Patten, Chattanooga, Tenn., October 19–21, 1955.

Tenth Engineering Conference, Rice Hotel, Houston, Texas, November 7–9, 1955.

Tenth Plastics-Paper Conference, Brooklyn Law School, Brooklyn, N. Y., November 14–15, 1955.

Forty-First Annual Meeting, Commodore Hotel, New York, N. Y., February 20–23, 1956.



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This huge calciner represents just one step in the TITANOX quality story. In this mammoth rotary kiln, titanium hydrate is converted to titanium dioxide. Here are developed, through careful heat treatment, the unique optical properties of TITANOX pigments—unsurpassed whitening, brightening and opacifying power.

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More and more users, who have been buying 50% caustic soda, are following the trend to 73% concentration. This practice is being advanced and advocated by Columbia-Southern because of the possible savings in delivered cost by converting to the higher concentration.

Naturally, your location and the volume of caustic soda consumed determine the savings realized in switching from 50% to 73% concentration. But, regardless of the amount of caustic soda you use, we suggest you investigate the possible savings in your operation.

The examples of annual savings shown on the sign post are taken from customers' records, selected at random, who converted to 73% caustic soda.

We believe it will pay you to look into the savings of buying 73% rather than 50%. The services of our technical staff are at your disposal. We shall be glad to confer with you, make recommendations, and supply data. Write our Pittsburgh office today.

CUSTOMER "A" SAVED $2,850 THE FIRST YEAR

CUSTOMER "B" SAVED $2,650 THE FIRST YEAR

CUSTOMER "C" SAVED $3,500 THE FIRST YEAR

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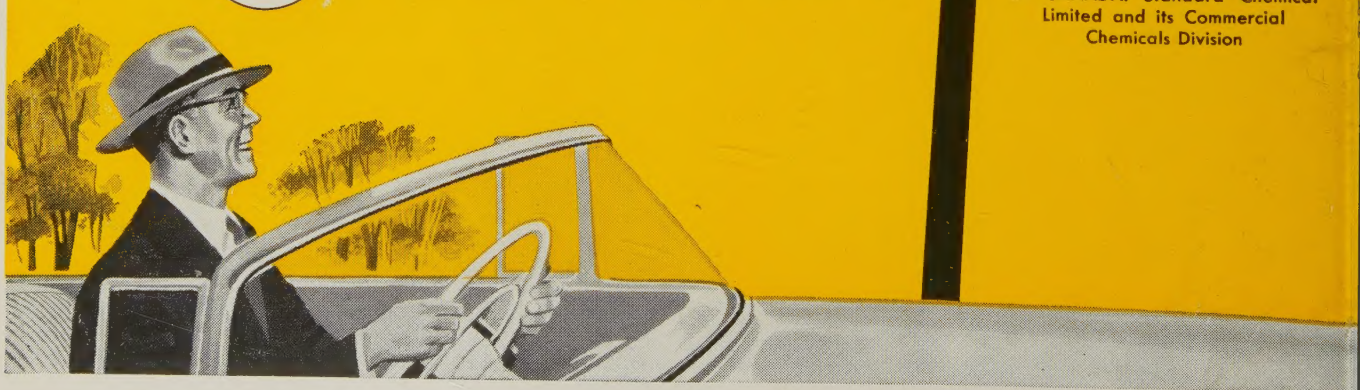
IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division